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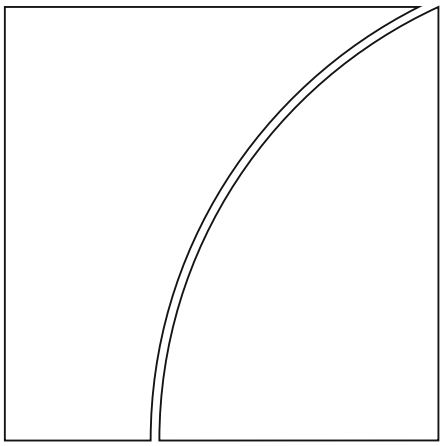
September 2014



International banking and financial market developments

BIS Quarterly Review
Monetary and Economic Department

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Special Features

Notations used in this Review

billion	thousand million
e	estimated
lhs, rhs	left-hand scale, right-hand scale
$	US dollar unless specified otherwise
...	not available
.	not applicable
–	nil or negligible

Differences in totals are due to rounding.

The term "country" as used in this publication also covers territorial entities that are not states as understood by international law and practice but for which data are separately and independently maintained.

Volatility stirs, markets unshaken[1]

Following a prolonged period of unusual tranquillity, volatility in financial markets ticked upwards in early August. Risk appetite took a dent, as escalating geopolitical tensions added to renewed concerns about the recovery. Equity prices fell, especially in Europe, high-yield credit spreads widened significantly, and yields of safe haven assets such as short-maturity German bunds fell into negative territory. But markets quickly rode out the turbulence. By early September, they had already recovered their losses, as worries over geopolitical tensions gave way to investors' anticipation of further monetary stimulus in the euro area.

After the spell of volatility in early August, the search for yield – a dominant theme in financial markets since mid-2012 – returned in full force. Volatility fell back to exceptional lows across virtually all asset classes, and risk premia remained compressed. By fostering risk-taking and the search for yield, accommodative monetary policies thus continued to support elevated asset price valuations and exceptionally subdued volatility.

Financial markets reflect shifting macro risks

In recent months, shifting risks with respect to the economic recovery in advanced economies proved to be a main factor affecting asset prices. From early July onwards, emerging signs of economic weakness in euro area core countries weighed on markets, and sentiment took another hit as banking sector worries re-emerged in Portugal (Graph 1, left-hand panel). From late July onwards, heightened geopolitical tensions added to these headwinds. In particular, the European Union's announcement of new economic sanctions against Russia on 29 July sparked a sell-off in financial markets. In this spell of market turbulence, global equities retreated, led by a fall on the main European bourses of 5–9% on average. During the market turbulence, US equities held up despite the geopolitical jitters, supported by

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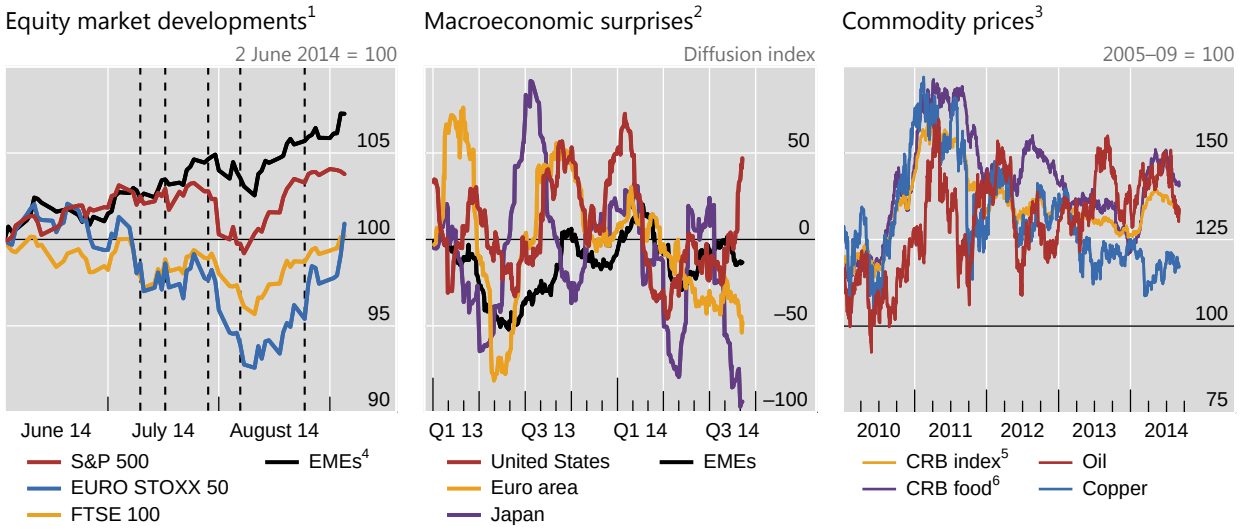
Asset prices reflect shifting macro risks

Graph 1



The dashed vertical lines in the left-hand panel indicate selected news and announcements in 2014: the suspension of trading in shares of Banco Espírito Santo (10 July); the downing of flight MH17 in eastern Ukraine (17 July); the EU announcement of additional sanctions against Russia (29 July); Russia's announcement of import bans (7 August); and the next business day after the speech by ECB President Mario Draghi at the annual central bank symposium in Jackson Hole (25 August).

[1] Stock market indices, in local currency terms. [2] Citigroup Economic Surprise indices; defined as weighted historical standard deviations of macro data surprises (actual releases versus Bloomberg survey median). A positive reading suggests that economic releases have on balance been beating consensus. The indices are calculated daily in a rolling three-month window. The weights of economic indicators are derived from relative high-frequency spot FX impacts of one standard deviation data surprises. [3] For oil, West Texas Intermediate Cushing crude oil spot price, in US dollars/barrel; for copper, grade A copper spot price, in US dollars/metric tonne. CRB = Commodity Research Bureau. [4] MSCI Emerging Markets equity index. [5] CRB BLS spot index. [6] CRB BLS spot foodstuffs sub-index.

Sources: Bloomberg; Datastream.

positive data surprises (Graph 1, centre panel), eg on labour market developments and a strong earnings season by US corporations. Similarly, emerging market economy (EME) equities proved by and large resilient against the market ructions. But high-yield credit markets did experience a hiccup; credit spreads moved up, especially in the lowest-rated market segment (see below).

Increased geopolitical stress had surprisingly little effect on energy markets. In the spot market, oil prices actually fell by around 11% between end-June and early September (Graph 1, right-hand panel). Market expectations for oil demand were revised down, largely on disappointing growth in the euro area and Japan. Incoming data from China were mixed, with that country's manufacturing PMI registering an 18-month high in July, but falling back in August. All in all, demand factors seemingly offset concerns over potential short-run supply disruptions.

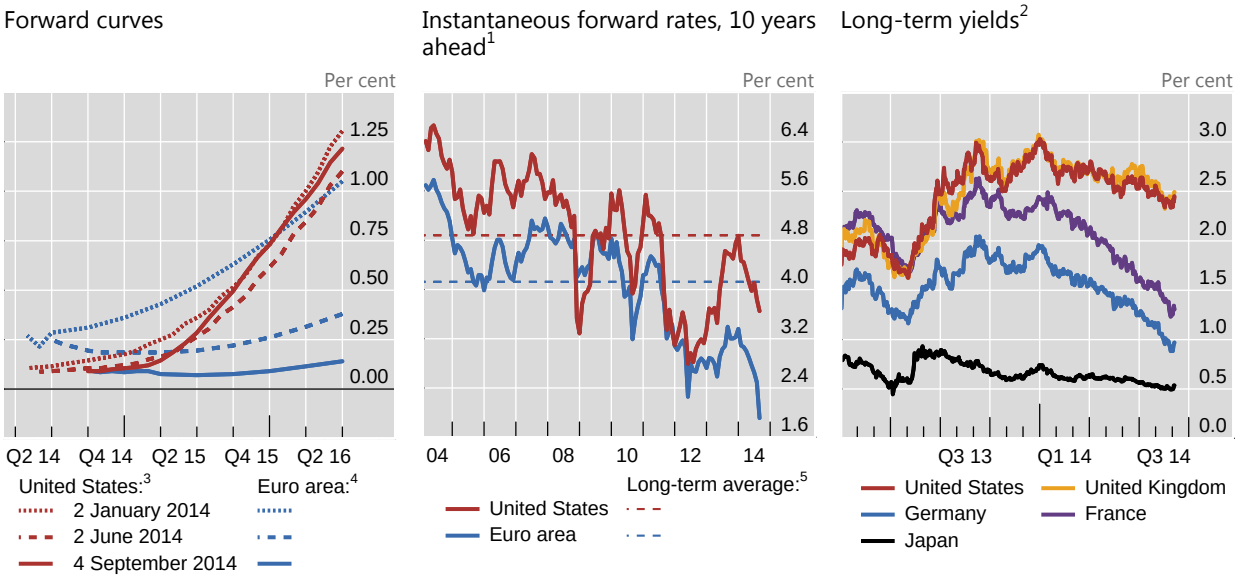
The spell of market volatility proved to be short-lived and financial markets resumed their rally soon afterwards. By early September, global equity markets had recouped their losses and credit risk spreads once again consolidated at close to historical lows. While geopolitical worries kept weighing on financial market developments, these were ultimately superseded by the anticipation of further monetary policy accommodation in the euro area, providing support for asset prices.

Diverging economic outlook feeds expectation of asynchronous exit

Differences in the strength of the recovery among advanced economies fed expectations of a divergence in monetary policies. Despite additional ECB measures in early June, persistent disinflationary pressures manifested themselves increasingly in a number of gauges of inflation expectations. By the end of August, following remarks by ECB President Mario Draghi at the Jackson Hole conference, market participants started to look for further monetary stimulus, shifting forward rates down (Graph 2, left-hand panel). Additional ECB measures were announced in early September, including interest rate cuts and purchase programmes for asset-backed securities and covered bonds. In response, two-year bond yields moved into negative territory for a number of euro area sovereigns, including – besides Germany – Austria, Belgium, France, Ireland and the Netherlands. These developments contrast with expectations that the US Federal Reserve will embark on a gradual scaling-back of monetary policy accommodation. In line with earlier communications, investors expected the Fed to end its asset purchases by October 2014. Moreover, investors looked for the US policy rate to start rising by mid-2015 and to increase to 125 basis points over the following one-year period. Forward rates pointed to similar expectations for the United Kingdom's policy rate.

Expectations about the path of monetary policy were also reflected in longer-maturity bond prices. Central bank communication that interest rates would be permanently lower in the post-crisis environment has shaped yield curve movements. For example, the instantaneous forward rate 10 years ahead – a gauge for long-term expectations of future short-term rates – dropped well below its 10-year average in both the United States and the euro area (Graph 2, centre panel). This measure contains a term premium in addition to expectations of future short term interest rates. Disentangling the two is difficult, but some commonly used models suggest that the term premium has fallen significantly in 2014, reversing

Bond markets anticipate divergence in the monetary policy outlook… Graph 2



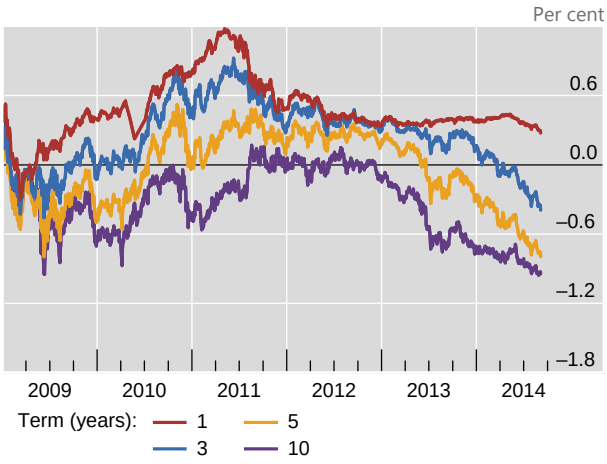
[1] Derived from the Libor/swap curve, month-end data. [2] Ten-year government bond yields. [3] Thirty-day federal funds rate futures. [4] Three-month Euribor futures. [5] Simple average for the period shown.

Sources: Bloomberg; Datastream; national data; BIS calculations.

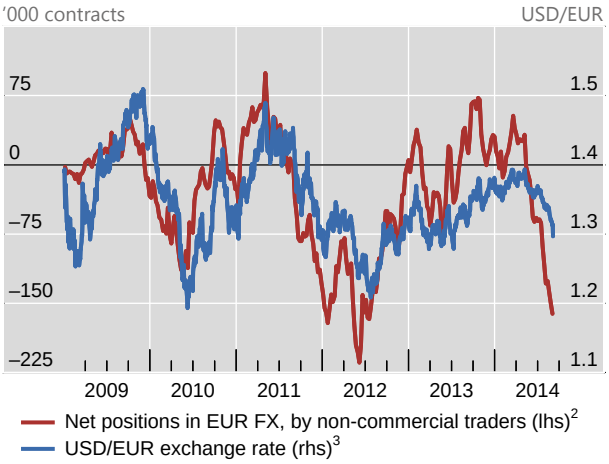
...as do currency markets

Graph 3

Rate differentials (advanced economies) against US[1]



Positioning in USD/EUR futures



[1] Based on interest rate swaps. Weighted average, based on bilateral trade in 2008–10 (weights in parentheses), across Australia (0.02), Canada (0.29), the euro area (0.38), Japan (0.19), Norway (0.01), Sweden (0.02), Switzerland (0.03) and the United Kingdom (0.07). [2] *Commitments of Traders – Financial Futures* report, US Commodity Futures Trading Commission (CFTC); a negative number indicates aggregate net short positions in euro FX futures taken by non-commercial traders. [3] A decline indicates a depreciation of the euro.

Sources: Bloomberg; BIS calculations.

part of the normalisation in the second half of last year. Anticipation of further monetary stimulus helped to nudge long-term euro area benchmark yields to exceptional lows. From mid-August onwards, German 10-year bond yields dropped below 100 basis points for the first time ever (Graph 2, right-hand panel). French, Italian and Spanish bond yields moved in lockstep, keeping intra-euro area sovereign spreads largely unchanged. Surprisingly, in spite of expectations of a first policy rate hike in 2015, yields on UK and US long-term government bonds fell as well. However, the decline was considerably less than in the euro area. As a consequence, US and UK bond spreads widened markedly relative to core euro area benchmark bonds. In early September, the yield on US 10-year bonds stood at 2.4%, respectively 110 and 145 basis points over French and German bond yields, with UK bonds just marginally higher at 2.45%.

Diverging monetary policies were an increasingly important factor in currency markets too. For a range of advanced economies, interest rate differentials vis-à-vis those of the United States have shrunk considerably or even turned negative since mid-2013 (Graph 3, left-hand panel), dulling the US dollar's appeal as a funding currency. At the same time, low yields on euro-denominated assets for the foreseeable future led investors to revise down their expectations regarding the euro exchange rate. In futures markets, CFTC positioning data confirmed that non-commercial traders (eg speculative investors such as hedge funds) strongly increased the size of their (net) short positions in the euro against the US dollar starting in early May and, once again, from mid-July onwards (Graph 3, right-hand panel). In spot markets, the euro dropped 6.5% against the US dollar between May and early September, helped on its way by the additional monetary stimulus announced by the ECB.

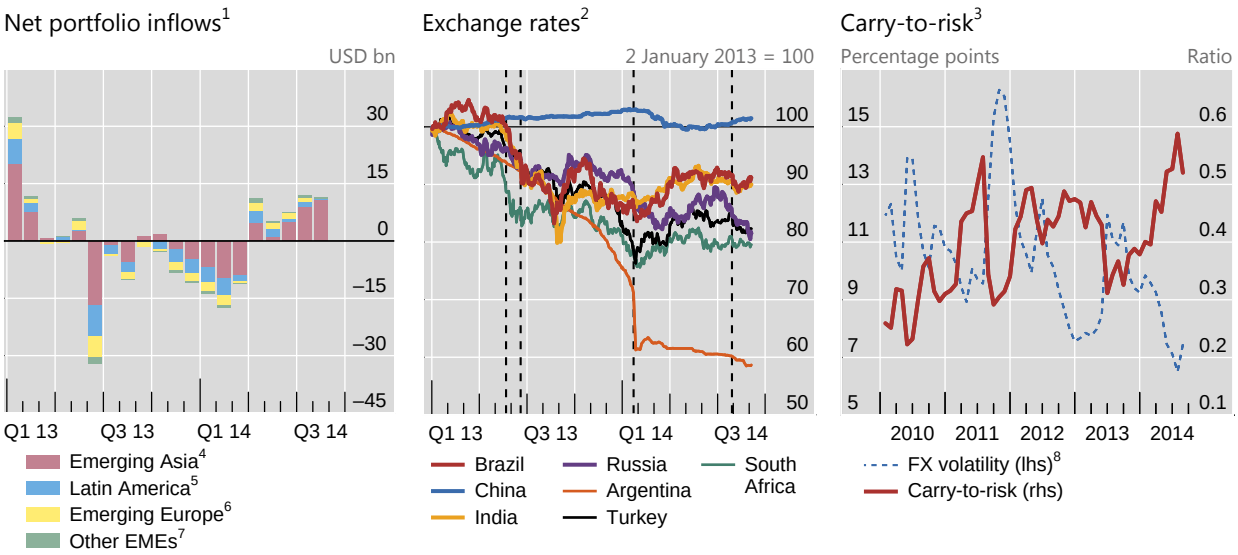
Emerging market economies prove resilient to market jitters

Many emerging market economies benefited from the benign financial conditions during most of the review period, which provided these economies with some relief from the market pressures they had faced in mid-2013 and early 2014.[2] Portfolio flows into EMEs recovered across all major regions early in the second quarter, partially reversing the outflows seen in the months before (Graph 4, left-hand panel).

The recovery of many EME asset prices suggests that the search for yield – despite the jitters in late July and early August – remained in full force during the review period. In this environment, 10-year local currency bond yields fell to around 5.8% in late August, some 50 basis points below their level in February 2014. Yields on US dollar-denominated EME sovereign bonds fell by as much as 80 basis points, to 4.8%. At the same time, many EME currencies stabilised (Graph 4, centre panel).

Emerging market economies recover from market pressures

Graph 4



The dashed vertical lines in the centre panel indicate news and announcements by the Federal Reserve on 22 May and 19 June 2013 related to the prospect of tapering of its asset purchases; the large depreciation of the Argentine peso on 23 January 2014; and the EU announcement of additional sanctions against Russia on 29 July 2014.

[1] Net portfolio flows (adjusted for exchange rate changes) to dedicated funds for individual countries and to funds for which country or regional decomposition is available. Monthly sums of weekly data across the countries listed. [2] US dollars per unit of local currency. A decline indicates a depreciation of the local currency. [3] Carry-to-risk is a gauge of the ex ante attractiveness of currency carry trades, and is defined as the interest rate differential (derived from the forward discount) divided by implied FX volatility. Simple average across currency pairs of Brazil, Chile, India, Israel, Korea, Mexico, the Philippines, Poland, South Africa, Thailand and Turkey; based on monthly averages of daily data. [4] China, Chinese Taipei, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [5] Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. [6] The Czech Republic, Hungary, Poland, Russia and Turkey. [7] Israel, Saudi Arabia, South Africa and the United Arab Emirates. [8] Implied volatility of one-month FX options.

Sources: Datastream; EPFR; BIS calculations.

[2] EME corporates and sovereigns have issued record amounts of local and foreign currency-denominated debt securities in recent years (see B Gruić, M Hattori and H S Shin, "Recent changes in global credit intermediation and potential risks", *BIS Quarterly Review*, September 2014, pp 17–18), which makes these borrowers potentially vulnerable to deteriorating global funding conditions and sharp exchange rate movements. See M Chui, I Fender and V Sushko, "Risks related to EME corporate balance sheets: the role of leverage and currency mismatch", *BIS Quarterly Review*, September 2014, pp 35–47).

Low foreign exchange volatility was an important factor, as it increased the attractiveness of carry trades targeting EME currencies (Graph 4, right-hand panel). In this environment, several central banks in EMEs, including those of Chile, Hungary, Korea, Peru and Turkey, cut policy rates amid weaker activity and lower inflation. By contrast, the central banks of Colombia, Malaysia, Russia and South Africa raised policy rates in the face of macroeconomic or financial stability risks.

The uptick in market volatility in early August had relatively little, and even then only a temporary, impact on most EMEs. There was no broad-based retreat by fund investors, in contrast with the sell-off following the mid-2013 tapering announcement.[3] Instead, portfolio flows to Latin America and emerging Europe stagnated, whereas flows into emerging Asia kept up their momentum throughout August. Some repricing of risk took place in EME sovereign and corporate bond markets, but yields remained well below the levels seen earlier in 2014, hovering at close to historical lows. In that context, EME bonds were among the top-performing asset classes in global financial markets in 2014, with US dollar-denominated EME debt registering a total return of almost 10% up to late July, maintaining most of its gain during the early August volatility spell.

However, market participants did not entirely ignore country-specific risks. For example, bond yields in Argentina increased significantly when the country defaulted for technical reasons on its (restructured) debt, even though trading volumes were very low. Similarly, the Russian rouble depreciated by 9% from end-June to early September as investors worried about the escalation of the Ukraine crisis (Graph 4, centre panel). In general, emerging Europe currencies and equities underperformed those of other EME regions, reflecting concerns about the possible effects of geopolitical factors on growth.

High-yield bond markets experience a hiccup

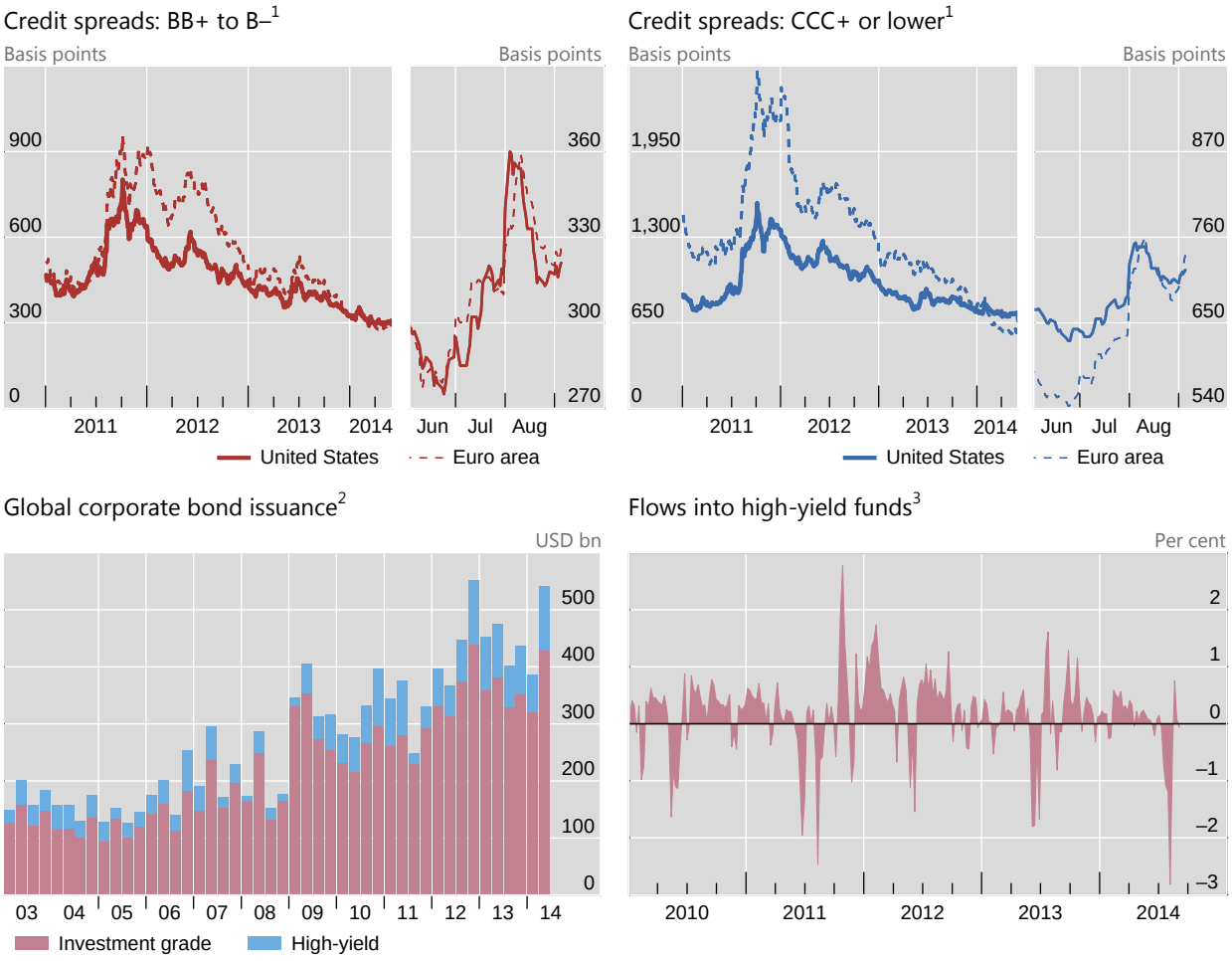
Corporate credit markets experienced a short-lived sell-off during the market jitters from late July to early August, especially in the advanced economies' sub-investment grade segment (Graph 5, top panels). On the back of low volatility and investors' persistent search for yield, high-yield bonds posted spectacular gains from mid-2012. At the same time, investors had absorbed an increasing amount of debt issued by lower-rated corporate borrowers (Graph 5, bottom left-hand panel). Around 35% of the debt issued by European and US corporates in the second quarter of 2014 was rated below investment grade (BB+ or lower). Such a large share of high-yield debt was by no means unprecedented for US corporates; for instance, it was even higher during the run-up to the global financial crisis in 2004–07. But this proportion represented a record high for corporates in the euro area, where market-based finance has traditionally played a subordinate role to bank financing.

With junk bond spreads touching record lows in June (Graph 5, top panels), investors became increasingly wary of high valuations. Thus, the asset class became more vulnerable to sudden shifts in sentiment. High-yield spreads had already ticked up by around 40 basis points between mid-June and mid-July. And, when risk

[3] Bank lending to EMEs also slowed significantly in mid-2013, particularly for borrowers in countries with high current account deficits or a large share of US dollar-denominated bank liabilities (see S Avdjiev and E Takáts, "Cross-border bank lending during the taper tantrum: the role of emerging market fundamentals", *BIS Quarterly Review*, September 2014, pp 49–60).

A hiccup in high-yield credit markets

Graph 5



[1] High-yield option-adjusted spreads on an index of local currency bonds issued by financial and non-financial corporates. [2] Gross issuance of corporate bonds by private non-financial corporations. [3] Weekly flows into funds that invest in US and western European high-yield corporate bonds, as a percentage of net total assets.

Sources: Bank of America Merrill Lynch; Dealogic; EPFR; BIS calculations.

appetite waned in late July and early August, the sell-off in junk bond markets accelerated. Selling pressure in secondary markets probably originated from retail investors redeeming a record amount of almost $20 billion from mutual funds dedicated to the asset class between early July and early August. When expressed as a share of net asset values, this outflow exceeds for instance the outflows from the asset class during the mid-2013 turmoil (Graph 5, bottom right-hand panel). From 29 July to 8 August, the bond spreads of US and European corporates in the lowest-rated high-yield segment (CCC+ and lower) spiked by around 70 basis points and 130 basis points, respectively. Junk bonds with better ratings (BB+ to B–) were less affected, rising only a respective 35 basis points and 48 basis points for US and European borrowers (Graph 5, top left-hand panel). The brief spike in high-yield spreads soon abated when institutional investors took the surge in spreads as a buying opportunity, as indicated by market commentary. By mid-August, markets had stabilised and spreads started to shrink again. The search for yield and accommodative global funding conditions were still very much in place at the end of the review period.

Volatility stirs, but reverts to lows

The short-lived turbulence in late July followed a prolonged period of calm in financial markets, during which volatility was extraordinarily subdued in all major asset classes (Graph 6, left-hand and centre panels). By early July 2014, the implied (forward-looking) volatility of bonds, equities, exchange rates and commodity prices (green dots in Graph 6, centre panel) had fallen well below historical averages (yellow dots), and in several cases even below pre-crisis levels (red dots).

The geopolitical tensions in late July triggered a temporary rise in volatility. The VIX nudged up to 17% in early August, about 7 percentage points higher than a month before. However, this short-lived pickup in volatility pales in comparison with the levels seen in the 1987 crash, the 2001 dotcom bubble burst, the 2007–09 financial crisis or the deepening of the European sovereign debt crisis in 2011.[4] And by late August, the VIX had already dropped back to 12% as investor risk appetite recovered and equity markets (in particular in the United States) resumed their rally. Volatility in other asset classes also fell back to the low levels seen in early July (black crosses in Graph 6, centre panel).

The current low level of volatility can be partly attributed to reduced macroeconomic uncertainty. Volatility is generally lower during business cycle expansions than in recessions, when uncertainty about macroeconomic and firm-specific fundamentals tends to be higher.[5] In fact, macroeconomic uncertainty has dropped significantly since the euro area sovereign debt crisis abated in mid-2012. At the same time, market participants' growth expectations have become much less dispersed, not only in advanced economies but also in major EMEs (Graph 6, right-hand panel). Greater macroeconomic stability gives rise to fewer surprises (eg regarding earnings or creditworthiness) and thus less need for portfolio rebalancing and trading. This, in turn, reduces the volatility of actual asset price movements.

The exceptionally accommodative monetary policy of recent years is also likely to have played a key role in driving volatility to such exceptional lows. Policy has had a direct effect, by compressing volatility in fixed income markets. For example, the reduction of interest rates to the effective lower bound in all major currency areas has pinched down the amplitude of interest rate movements at the short end of the yield curve. More transparent central bank communication, forward guidance and asset purchases have also removed uncertainty about interest rate changes for medium- and longer-term maturities.

By fostering the search for yield and influencing risk appetite in the market, accommodative policies have also had an indirect effect on volatility.[6] An environment of low yields on high-quality benchmark bonds – coupled with

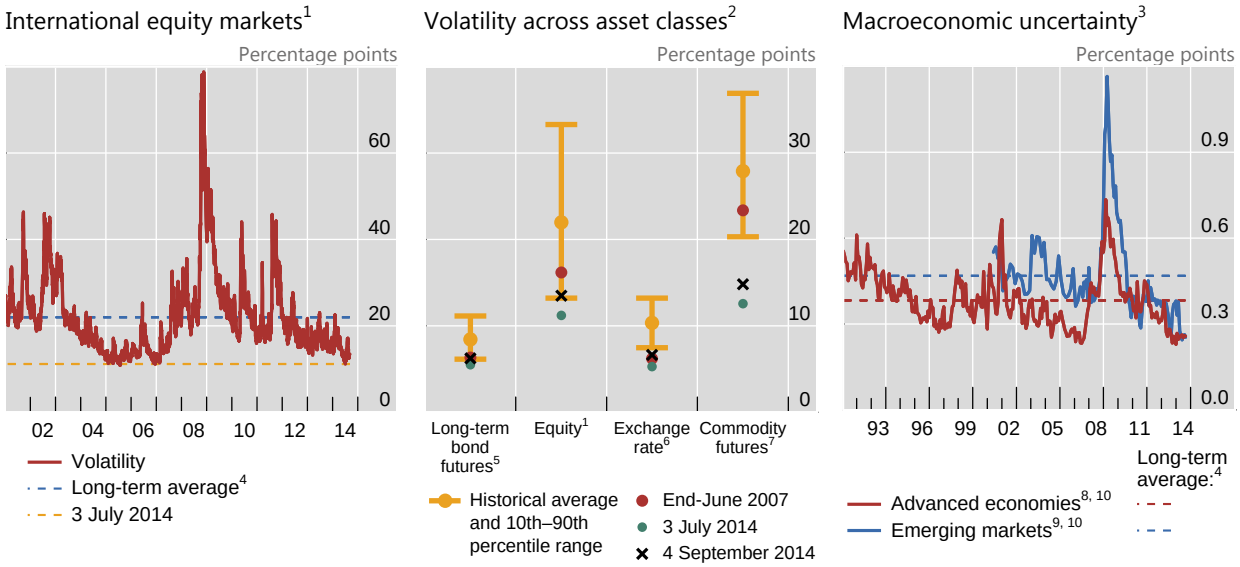
[4] Financial volatility (see the box for a discussion of various volatility concepts) is typically persistent, but also tends to revert to its mean over longer horizons. Bursts of volatility linked to specific events generally last up to several months, but also herald extended periods of relative calm. This volatility clustering effect becomes particularly apparent when taking a long-term perspective.

[5] In this regard, the current phase is akin to the two prior prolonged low-volatility episodes of 1993–2000 and 2004–07, which coincided with post-recession recoveries.

[6] The response of financial intermediaries to accommodative monetary conditions – taking greater risk – is known as the risk-taking channel of monetary policy. See BIS, *84th Annual Report*, Chapter II, June 2014, for a discussion of this monetary transmission channel.

Low volatility everywhere

Graph 6



[1] Implied volatility of S&P 500, EURO STOXX 50, FTSE 100 and Nikkei 225 equity indices; weighted average based on market capitalisation of the respective indices. [2] Data start in 2001. [3] Cross-sectional standard deviation of Consensus Economics respondents' forecasts of full-year real GDP growth, computed on a monthly basis. The series are weighted averages of current and next-year forecasts, with weights shifting as the year progresses to proxy a 12-month-ahead forecast. See P Gerlach, P Hördahl and R Moessner, "Inflation expectations and the great recession", *BIS Quarterly Review*, March 2011, pp 39–51) for details. [4] Simple average for the period shown. [5] Weighted average, based on 2005 GDP and PPP exchange rates, of the implied volatility of at-the-money options on long-term bond futures of Germany, Japan, the United Kingdom and the United States. [6] JPMorgan VXY Global index, a turnover-weighted index of implied volatility of three-month at-the-money options on 23 USD currency pairs. [7] Simple average of the implied volatility of at-the-money options on commodity futures contracts on oil, gold and copper. [8] Germany, Japan, the United Kingdom and the United States. [9] Brazil, China, Korea, Mexico and Turkey. [10] Weighted average of the economies listed, based on 2005 GDP and PPP exchange rates.

Sources: Bloomberg; Consensus Economics; BIS calculations.

investor confidence in the continuation of favourable market conditions – is set to foster risk-taking behaviour. This then tends to be reflected in lower hedging costs via options, as well as a general narrowing of risk premia. In fact, the decline in volatility across asset classes since mid-2012 has gone hand in hand with rising asset valuations and collateral values more generally. As the capital constraints faced by financial intermediaries are alleviated, these institutions have an incentive to take on more risk, sending asset prices higher. This potentially creates additional feedback effects, since return volatility tends to be dampened when valuations rise (see box). As market participants further revise down their perceptions of (market) risk, they may be inclined to take larger positions in risky assets, boosting prices and pushing volatility even lower.

There are also signs that investor confidence in the continuation of low volatility and ample funding at low rates has encouraged market participants to take increasingly speculative positions on volatility in derivatives markets. The popularity of such leverage-like investment strategies can be gauged from open interest in exchange-traded volatility derivatives (see Graph A, right-hand panel, and discussion in box). CFTC positioning data indicate further that speculative (non-commercial) traders have significant overall net short positions in VIX futures, a sign of their continued willingness to sell insurance to other investors against rising volatility, despite a fairly narrow volatility risk premium.

Volatility concepts and the risk premium

Marco Lombardi and Andreas Schrimpf

Financial volatility is a measure of the variability of asset prices (or asset returns) over time. As it is a multifaceted concept, several different volatility measures are used in practice. These fall into two broad categories: *statistical* volatility (ie the volatility of the actual return distribution) and *implied* volatility (ie the volatility of the returns implied in option prices).

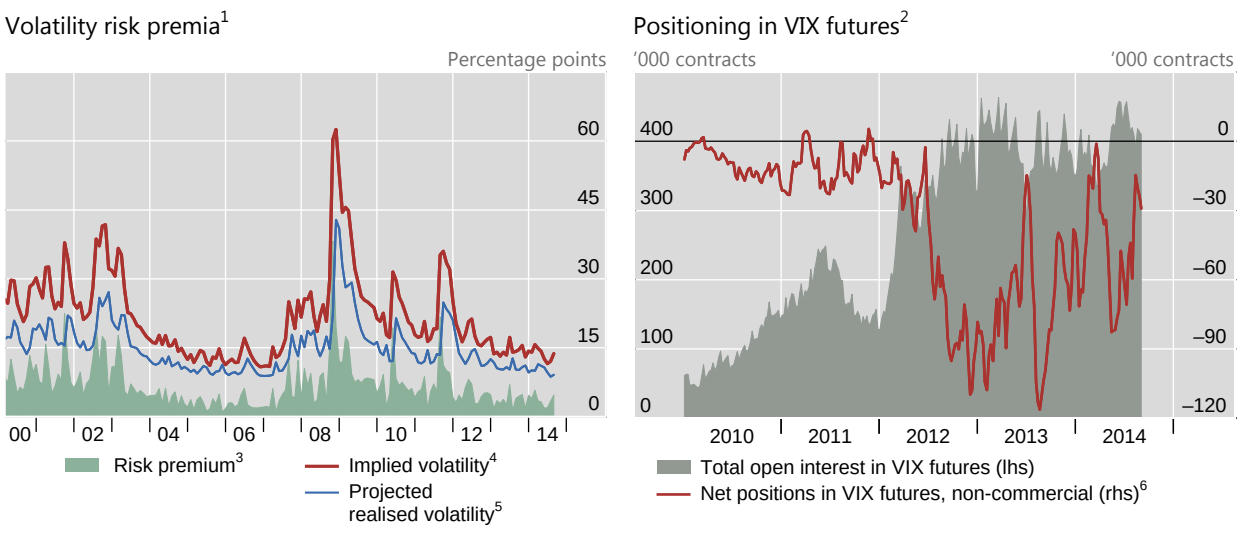
Statistical measures of volatility are based on observed asset returns over a given time interval. This can be done in various ways. A simple, model-free approach is to compute the standard deviation of the actual returns on a given asset over a particular time window, so-called realised (or "historical") volatility.① Model-based approaches have also been proposed: ARCH (autoregressive conditional heteroscedasticity) models, for example, assume that the variance of returns fluctuates over time according to a specific time series model.②

Implied volatility, by contrast, is derived using option prices. It thus embeds information about market participants' expectations of future movements in the price of the underlying asset as well as their appetite for holding that risk.③ The best known example is the volatility index (VIX), a model-free measure of implied volatility on the S&P 500. The VIX is constructed using option premia from a wide array of calls and puts, with a maturity of 30 days and a broad range of strike prices.④

By comparing measures of implied and statistical volatility, researchers and practitioners can infer the *volatility risk premium*. This premium can be thought of as the compensation demanded by investors for bearing risk related to sharp changes in market volatility. To isolate this premium, researchers often compare implied volatility (eg measured by the VIX) with a projection of realised volatility over the same horizon. For instance, Bekaert et al (2013; see Graph A, footnote 3) propose a simple approach to estimate expected realised volatility over a one-month horizon, and suggest that the difference between implied and projected realised volatility can be interpreted

Volatility risk premia and derivatives trading

Graph A



[1] Monthly averages of daily data. [2] *Commitments of Traders – Chicago Board Options Exchange* report, US Commodity Futures Trading Commission. [3] Estimate obtained as the difference between implied volatility (ie the volatility of the risk-neutral distribution of stock returns computed from option prices) and projected realised volatility (ie a projection of the volatility of the statistical return distribution). The difference between the two risk measures can be attributed to investors' risk aversion; see G Bekaert, M Hoerova and M Lo Duca, "Risk, uncertainty and monetary policy", *Journal of Monetary Economics*, vol 60, 2013, pp 771–88. [4] VIX, Chicago Board Options Exchange S&P 500 implied volatility index; standard deviation, in percentage points per annum. [5] Forward-looking estimate of realised volatility obtained from a predictive regression of one-month-ahead realised volatility on lagged realised volatility and implied volatility. Realised volatility is computed from five-minute-interval returns on the S&P 500 Index; standard deviation, in percentage points per annum. See T Anderson, F Diebold, T Bollerslev and P Labys, "Modeling and forecasting realized volatility", *Econometrica*, vol 71, March 2003, pp 579–625. [6] A negative number indicates aggregate net short positions in VIX futures taken by non-commercial traders.

Sources: Bloomberg; Oxford-Man Institute, http://realized.oxford-man.ox.ac.uk; BIS calculations.

as a proxy for investors' attitude towards risk. The red and blue lines in the left-hand panel of Graph A depict, respectively, the implied and projected realised volatility, and the green shaded area corresponds to the gauge of time-varying risk aversion.⑤ When volatility spikes in stress episodes, investors' attitude towards risk usually follows, as investors are less willing to hold positions in risky assets or to provide insurance against sharp asset price changes. More interestingly, estimates of the volatility risk premium have dropped quite substantially since mid-2012, and now stand at close to pre-crisis levels.

A well known empirical regularity is that volatility tends to be negatively correlated with current and past asset returns. In other words, volatility tends to be much higher when asset prices drop than when markets rally. The traditional interpretation of this asymmetric relationship is the so-called leverage effect.⑥ According to this explanation, a fall in equity prices would generally imply a rise in firms' leverage, and in turn raise the riskiness of a given stock. An alternative explanation relates the negative correlation to changes in attitudes towards risk: since low volatility is associated with increased willingness to take on risk, a low-volatility environment is likely to be accompanied by rising asset valuations.⑦

Recent economic theory emphasises the endogenous nature of volatility.⑧ A prolonged period of low volatility could paradoxically lead to a build-up in risk.⑨ One key mechanism relates to the effect of changes in volatility on measures such as value-at risk (VaR) or Sharpe ratios, extensively used to inform risk-taking and risk management by financial intermediaries. For a given VaR threshold, lower volatility increases the fraction of the portfolio that a financial institution can hold in risky assets. Similarly, for a given portfolio composition and amount of capital, lower volatility can also encourage the build-up of leverage to finance a larger asset portfolio. A second potential source for a build-up in risk in a low-volatility environment is crowded investment behaviour by asset managers and similar types of non-bank players.⑩ Expectations of the continuation of benign financial conditions and low volatility may encourage these market participants to build up large positions in riskier asset classes, which further compresses risk premia.

There are also signs of intensified speculative activity on volatility. As shown in Graph A, the size of net short positions on VIX futures held by non-commercial traders (eg hedge funds) – ie bets that volatility is going to stay low – has been increasing sharply on the back of low volatility since mid-2012. The graph also suggests that traders were quick to scale back such short positions during the taper tantrum episode in mid-2013, during the market turbulence of early 2014, and most recently during the market hiccup of late July to early August 2014.

① If one has access to high-frequency financial data (eg five-minute returns), realised volatility has been shown to be a highly accurate estimator of the diffusion component of the stochastic process driving the evolution of the price of the asset (Anderson et al (2003), op cit). ② The pricing of options is based on the principle of no arbitrage. To make this operational, the evolution of the asset on which the option is written has to be cast in a "risk-neutral" framework, in which the transition probabilities governing the evolution of the price of the underlying asset are adjusted for investors' attitude towards risk. In this sense, these "risk-neutral" probabilities differ from the "physical" probabilities governing the evolution of observed returns on the underlying asset. ③ See R Engle, "Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation", *Econometrica*, vol 50, 1982, pp 987–1007. ④ Recent work also stresses the possibility that implied volatility may partly reflect the risk-bearing capacity of dealers acting as intermediaries in option markets (eg N Gârleanu, L Pedersen and A Poteshman, "Demand-based option pricing", *Review of Financial Studies*, vol 22, 2009, pp 4259–99). ⑤ Some market participants use the term "risk appetite" to characterise investors' attitudes towards risk. The term "risk aversion" is more technical, and is related by some to innate agents' preferences. ⑥ See F Black, "Studies of stock price volatility changes", *Proceedings of the 1976 Meetings of the American Statistical Association, Business and Economic Statistics Section*, 1976, pp 177–81. ⑦ This interpretation of the observed negative correlation between volatility and asset returns was first put forth by R Pindyck, "Risk, inflation and the stock market", *American Economic Review*, vol 74, 1984, pp 335–51. ⑧ See eg H S Shin, *Risk and liquidity*, Oxford University Press, 2010; and T Adrian and N Boyarchenko, "Intermediary leverage cycles and financial stability", Federal Reserve Bank of New York, *Staff Reports*, no 576, August 2012. ⑨ This has been labelled, inter alia, the "financial instability paradox" or also "volatility paradox"; see C Borio and M Drehmann, "Towards an operational framework for financial stability: 'fuzzy' measurement and its consequences", *BIS Working Papers*, no 284, June 2009; and M Brunnermeier and Y Sannikov, "A macroeconomic model with a financial sector", *American Economic Review*, vol 104, no 2, 2014. ⑩ See K Miyajima and I Shim, "Asset managers in emerging market economies", *BIS Quarterly Review*, September 2014, pp 19–34.

Highlights of the BIS international statistics[1]

The BIS, in cooperation with central banks and monetary authorities worldwide, compiles and disseminates several data sets on activity in international financial markets. This chapter summarises the latest data for the international banking market, available up to end-March 2014, and analyses those for the international debt securities market, available up to end-June 2014.

Between end-December 2013 and end-March 2014, the cross-border claims of BIS reporting banks rose by $580 billion, the first substantial quarterly increase since late 2011. The expansion was broadly spread across countries and sectors. Claims on both advanced and emerging market economies grew considerably. At individual country level, claims vis-à-vis borrowers in China increased the most, taking the outstanding stock of cross-border claims on the country above $1 trillion at end-March 2014 (including inter-office transactions by Chinese and other banks). Claims on the rest of Asia, Latin America and Africa and the Middle East also increased, albeit at a more modest pace. By contrast, claims on emerging Europe fell for a fourth consecutive quarter.

The box on securities statistics highlights the recent change in the pattern of global credit intermediation from bank credit to bond finance and outlines potential risks. It focuses on emerging market corporate borrowers, whose issuance of international debt securities has surged in recent years, especially on a nationality basis that includes issuance by offshore subsidiaries. The box considers the likely implications of the lengthening of bond maturities for rollover risk. The need to roll over these debts in any future capital market disruptions has the potential to impose significant costs on the economy through slower growth and tighter financial conditions.

Recent developments in the international banking market

The first quarter of 2014 saw the first substantial expansion in international banking activity since late 2011. The cross-border claims of BIS reporting banks rose by $580 billion between end-December 2013 and end-March 2014. While not enough

[1] This article was prepared by Stefan Avdjiev (stefan.avdjiev@bis.org). Statistical support was provided by Sebastian Goerlich.

to offset the preceding quarterly declines, the rise caused the annual rate of contraction in cross-border claims to slow from 4.0% as of end-2013 to 2.0% as of end-March 2014.[2]

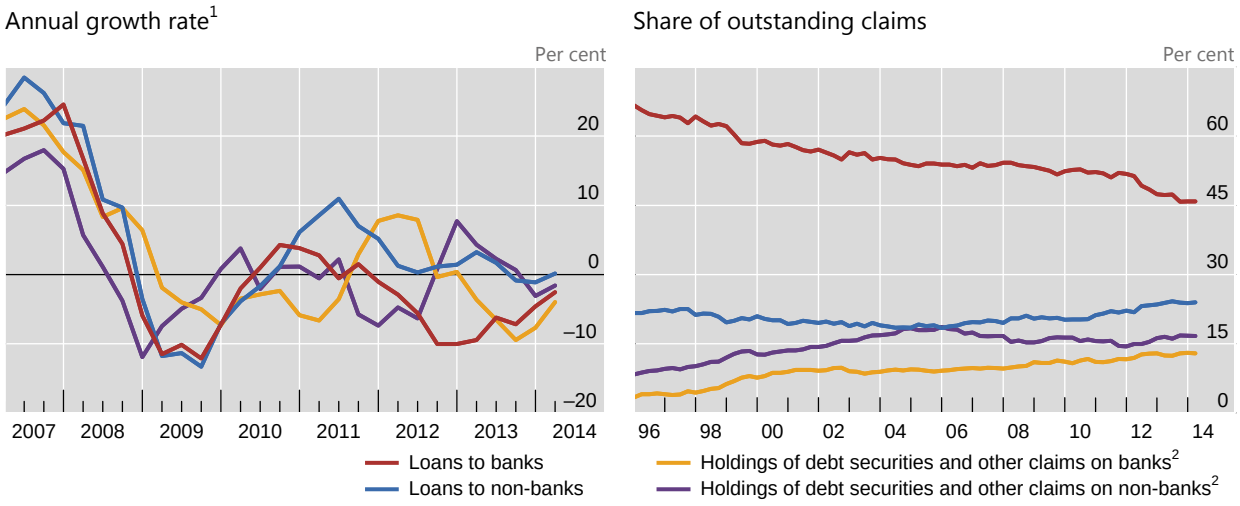
The upturn in overall activity in the first quarter of 2014 was boosted by the first quarterly increase in cross-border interbank claims since late 2011. Interbank claims, which in the locational banking statistics[3] capture positions with related offices as well as unrelated banks, rose by $298 billion. As a result, the annual rate of contraction of cross-border interbank activity slowed from 5.3% at end-December 2013 to 2.9% at end-March 2014. As usual, the expansion in interbank claims consisted almost entirely of loans (Graph 1, left-hand panel). Cross-border claims on other banks and related offices in the euro area, including intra-euro area activity, increased by $104 billion in the first quarter of 2014, ending a run of seven consecutive declines.

Matching the rise in cross-border interbank lending to the euro area, euro-denominated cross-border claims also grew during the first quarter of 2014. The $163 billion quarterly increase was the first since early 2012. It reduced the annual rate of contraction from 10% at end-2013 to 7.7% at end-March 2014.

Overall cross-border claims on non-banks – mainly non-bank financial institutions, governments and non-financial corporations – also grew between end-December 2013 and end-March 2014. The $282 billion rise was the largest since late 2010. While loans accounted for the bulk of the increase in the first quarter of

Cross-border claims of BIS reporting banks

By type of instrument and sector of counterparty — Graph 1



[1] Calculated as the sum of exchange rate- and break-adjusted changes over the preceding four quarters divided by the amount outstanding one year earlier. [2] Other claims include equities, derivatives and other financial claims not classified as loans, deposits or debt securities.

Source: BIS locational banking statistics by residence (Table 1).

[2] Annual percentage changes are calculated as the sum of exchange rate- and break-adjusted changes over the preceding four quarters divided by the amount outstanding one year earlier.

[3] The locational banking statistics are structured according to the location of banking offices and capture the activity of all internationally active banking offices in the reporting country regardless of the nationality of the parent bank. Banks record their positions on an unconsolidated basis, including those vis-à-vis their own offices in other countries.

2014 ($196 billion), BIS reporting banks continued to increase their holdings of non-banks' securities as well ($86 billion). However, the annual growth rate of their securities purchases remained lower than the growth rates seen in 2012 and 2013 (Graph 1, left-hand panel, purple line).

Cross-border lending to non-banks in the United States was especially strong, expanding by $73 billion in the first quarter of 2014. The BIS consolidated banking statistics[4] on an immediate borrower basis suggest that the majority of this rise reflected increased lending to the US non-bank private sector, whose share of all international claims on the United States rose by a full percentage point (from 52.0% to 53.0%) between end-December 2013 and end-March 2014. By contrast, the share of claims on the US public sector declined by 0.7 percentage points (from 23.5% to 22.8%) during the same period.

Notwithstanding the latest quarterly upturn in cross-border interbank loans, their share of overall cross-border claims has gradually declined, from roughly two thirds at end-1995 to 46% at end-March 2014 (Graph 1, right-hand panel, red line). By contrast, the share of cross-border loans to non-banks, which remained stable at around 20% between end-1995 and end-2005, has grown over the past few years, reaching 24% at the end of March 2014 (blue line). In the meantime, the share of banks' cross-border holdings of securities issued by non-banks more than doubled between end-1995 and end-2005 (from 8% to 19%) before retreating to 17% as of end-March 2014 (purple line). Finally, the share of banks' cross-border holdings of securities issued by other banks increased from 3% at the end of 1995 to 13% at the end of March 2014 (yellow line).

Credit to emerging market economies

Cross-border lending to emerging market economies continued to grow in the first quarter of 2014. The $166 billion increase for the period brought the annual growth of claims on emerging markets to 10% at end-March 2014.[5]

Just as in the preceding several quarters, the main driver of the expansion during the first quarter of 2014 was lending to China, which rose by $133 billion. This took the annual growth rate of claims on China to 49%. At end-March 2014, the outstanding stock of cross-border claims on China stood at just over $1 trillion, with interbank claims accounting for almost three quarters ($726 billion) of that amount. The consolidated banking statistics indicate that a significant share of the reported cross-border claims on China – over $400 billion – is booked by banks headquartered outside the BIS reporting area through their offices in BIS reporting countries: for example, through Chinese banks located in Hong Kong SAR.[6, 7] By

[4] The consolidated banking statistics are structured according to the nationality of reporting banks and are reported on a worldwide consolidated basis, ie excluding positions between affiliates of the same banking group. Banks consolidate their inter-office positions and report only their claims on unrelated borrowers.

[5] For an analysis of the main drivers in the deceleration in cross-border bank lending to emerging market economies (EMEs) during the 2013 taper tantrum using data from the Stage 1 enhanced BIS international banking statistics, see S Avdjiev and E Takáts, "Cross-border bank lending during the taper tantrum: the role of emerging market fundamentals", *BIS Quarterly Review*, September 2014, pp 49–60.

[6] A list of countries in the BIS reporting area is available on the BIS website: www.bis.org/statistics/rep_countries.htm. China does not report international banking statistics to the BIS. However, the locational statistics and consolidated statistics on an immediate borrower

comparison, the consolidated foreign claims of banks headquartered inside the BIS reporting area on Chinese residents totalled $796 billion on an ultimate risk basis at end-March 2014.[8]

Claims on the rest of emerging Asia also grew (by $21 billion) during the first quarter of 2014, but at a much more moderate pace than those vis-à-vis China (7.8% on an annual basis).

Just as in the preceding quarter, claims on Latin America and the Caribbean grew at a very modest pace during the quarter. Claims on the region rose, but only by $8.9 billion. Internationally active banks increased their claims on Brazil by $7.6 billion. By contrast, cross-border lending to residents of Mexico contracted by $3.7 billion.

Cross-border lending to emerging Europe fell for the fourth consecutive quarter. The $15 billion contraction, which was larger than any of the three that preceded it, caused claims on the region to fall by 1.9% on an annual basis. At individual country level, claims on Turkey and Poland shrank the most (by $5.3 billion and $4.8 billion, respectively). By contrast, claims on Hungary rose by $1.3 billion in the first quarter of 2014.

As the geopolitical uncertainty surrounding Russia and Ukraine increased in the first quarter of 2014, internationally active banks reported declines in (the US dollar value of) their consolidated foreign claims on both countries. The consolidated banking statistics on an ultimate risk basis reveal that the outstanding stock of foreign claims on Russia declined from $225 billion at end-December 2013 to $209 billion at end-March 2014, while those on Ukraine dropped from $25 billion to $22 billion.[9] However, these reported reductions in foreign claims were amplified by the sharp depreciation in the value of these countries' currencies against the US dollar during the first quarter of 2014, which reduced the US dollar value of claims booked in local currencies through local affiliates.[10] The locational banking statistics indicate that, on an exchange rate-adjusted basis, cross-border claims on residents of Russia remained virtually unchanged in the first quarter of 2014 (–$0.3 billion), while those on Ukraine declined by $1.5 billion (–15% on an annual basis).

basis capture the positions of Chinese and other banks headquartered outside the BIS reporting area to the extent that these positions are booked through offices in a BIS reporting country.

7 See P McGuire and A Van Rixtel, "Shifting credit patterns in emerging Asia", *BIS Quarterly Review*, December 2012, pp 17–18.

8 Foreign claims comprise cross-border claims and local claims, where local claims refer to credit extended by foreign banks' affiliates located in the same country as the borrower. BIS reporting banks' local claims on China denominated in renminbi totalled $235 billion at end-March 2014.

9 For the outstanding stocks of foreign claims on Russia and Ukraine at end-2013, broken down by the nationality of the lending bank, see Graph 2 in Bank for International Settlements, "Highlights of the BIS international statistics", *BIS Quarterly Review*, June 2014, pp 1–11.

10 The depreciation of a currency against the US dollar results in a decline in the reported US dollar value of the outstanding stock of claims denominated in that currency.

Recent changes in global credit intermediation and potential risks

Branimir Gruić, Masazumi Hattori and Hyun Song Shin

Global credit intermediation has seen a marked shift from the banking sector to the debt securities market, reflecting the combination of subdued cross-border banking activity in 2009–12 and portfolio investors' search for yield in a low-yield environment. The shift is particularly notable for emerging market corporate borrowers, where the amounts outstanding by nationality (based on location of headquarters) exceed the traditional residence-based amounts (Graph A, left-hand panel), indicating substantial offshore issuance not captured in conventional external debt statistics. See Chui et al (2014)① for a more detailed description of borrower characteristics and exposures.

The average maturity of international debt securities newly issued by EME corporate borrowers has been increasing. The centre and right-hand panels of Graph A depict the amount and average maturity of gross issuance of international debt securities by EME non-bank corporates.② The size of the bubble represents the dollar amount while the height of the bubble represents average maturity weighted by issuance amount. Graph A shows increased issuance amounts in recent years (larger bubbles) as well as longer maturities, especially for the residence-based series. In terms of the stock of outstanding debt securities by residence, the average remaining maturity excluding money market instruments now exceeds eight years.

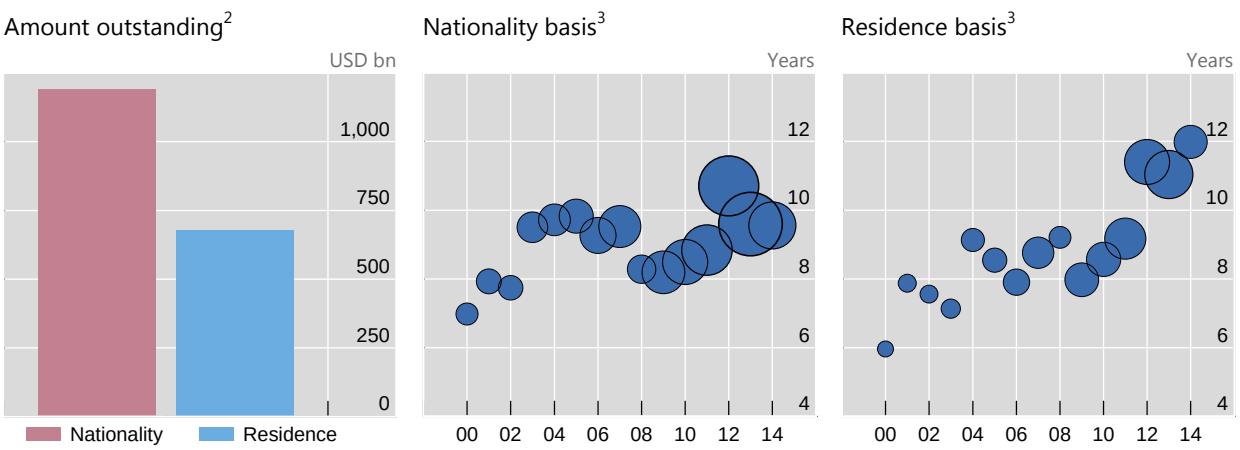
Longer maturities mitigate rollover risk for borrowers, but this is achieved at the expense of greater sensitivity of bond prices to yield changes – greater duration risk for the lender. Although many bond investors such as institutional investors do not operate with much leverage, if any, they may be susceptible to leverage-like behaviour if they are subject to risk limits, are sensitive to relative performance metrics, or engage in dynamic hedging to offset losses from option selling and other return-enhancing practices. To the extent that investor reactions amplify market disruptions, longer maturities may introduce new vulnerabilities with the potential to affect the availability and cost of finance. These issues are examined in more detail in Miyajima and Shim (2014).③

The projected redemption schedules for EME non-bank corporates based on international debt securities issued to date indicate that redemptions will peak in 2017–18. For international debt securities, redemptions in US dollars take the lion's share (Graph B, left-hand and centre panels).

This represents a potential vulnerability. Many emerging market borrowers, such as commodity exporters, will have US dollar cash flow to offset coupon payments, as detailed in Chui et al (2014).① Nevertheless, currency

Annual gross issuance and maturity (weighted average)

Emerging market non-bank corporations[1] Graph A

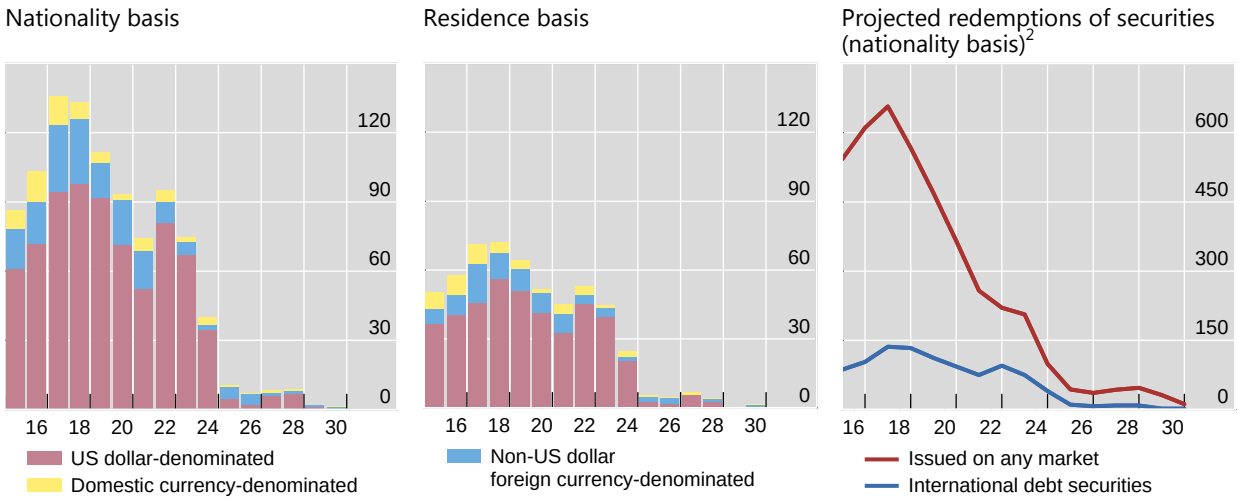


[1] Non-financial corporations and non-bank financial corporations from Brazil, Bulgaria, Chile, China, Colombia, the Czech Republic, Estonia, Hong Kong SAR, Hungary, Iceland, India, Indonesia, Korea, Latvia, Lithuania, Malaysia, Mexico, Peru, the Philippines, Poland, Romania, Russia, Singapore, Slovenia, South Africa, Thailand, Turkey and Venezuela. [2] End-June 2014. [3] Nationality basis refers to firms with headquarters in the selected countries. Residence basis refers to firms resident in the selected countries. The size of bubbles reflects relative volume of annual gross issuance of long-term securities. Gross issuance for 2013: $265 billion (nationality basis) and $152 billion (residence basis). For 2014, data up to June.

Sources: Bloomberg; Dealogic; Euroclear; Thomson Reuters; Xtrakter; BIS.

Projected redemptions[1]

Emerging non-bank corporations, in billions of US dollars — Graph B



[1] Projected redemptions on international debt securities issued to date of non-bank corporations in the economies listed in Graph A. Nationality basis measures projected redemptions of corporates with headquarters in the selected countries. Residence basis measures redemptions of corporates resident in the selected countries. Domestic currency refers to domestic currency in nationality terms. [2] Projected redemptions of long-term securities issued on any market (source: Dealogic) and securities that met the BIS criteria (international debt securities).

Sources: Dealogic; Euroclear; Thomson Reuters; Xtrakter; BIS.

hedging of principal redemptions may be incomplete even for such borrowers. To the extent that market disruptions are made worse by duration risk, lengthening maturities may have the perverse effect of exacerbating rollover problems if the US dollar debt securities market shuts down in a distress episode. It should be remembered that the dollar market for emerging market issuers all but closed between September and October in 2008 and in January 2009, and again for several weeks in mid-2013.

International debt securities constitute around 20% of total debt securities in terms of amounts outstanding.④, ⑤ Graph B (right-hand panel) shows the projected redemptions of international debt securities relative to redemptions of all debt securities, including domestic issuance. Domestic debt securities are denominated mainly in the domestic currency, eliminating the immediate risk from currency mismatch. However, as international investors have ventured further into the market for domestic debt securities, even this market may not be immune to disruptions arising from exits by global investors.

While solvency is less of a problem with non-leveraged investors, the broader macroeconomic impact of capital market disruptions may impose significant costs on the economy through slower growth and tighter financial conditions. For these reasons, recent trends in the debt securities market and the changing pattern of credit intermediation merit attention from policymakers.

① M Chui, I Fender and V Sushko, "Risks related to EME corporate balance sheets: the role of leverage and currency mismatch", *BIS Quarterly Review*, September 2014, pp 35–47. ② The BIS classifies a debt security as international (IDS) if any one of the following characteristics is different from the country of residence of the issuer: country where the security is registered, law governing the issue, or market where the issue is listed. All other securities are classified as domestic (DDS). See B Gruić and P Wooldridge, "Enhancements to the BIS debt securities statistics", *BIS Quarterly Review*, December 2012, pp 63–76. ③ K Miyajima and I Shim, "Asset managers in emerging market economies", *BIS Quarterly Review*, September 2014, 19–33. ④ Investments in debt securities by non-residents account for roughly one quarter of the stock of global debt securities, with domestic investors accounting for the remaining 75%. See B Gruić and A Schrimpf, "Cross-border investments in global debt markets since the crisis", *BIS Quarterly Review*, March 2014, pp 18–19. ⑤ For the economies listed, share of outstanding IDS by residence at end-2013 was around 1% in long-term series on credit to the private non-financial sector. See C Dembiermont, M Drehmann and S Muksakunratana, "How much does the private sector really borrow – a new database for total credit to the private non-financial sector", *BIS Quarterly Review*, March 2013, pp 65–81. It is reasonable to assume that large non-financial corporates in the economies tap international debt securities market.

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Asset managers in emerging market economies[1]

The turbulence in emerging market economies (EMEs) in mid-2013 has reminded policymakers and investors of the importance of actions by large asset managers for relatively small and illiquid EME asset markets. The presence of asset managers in EMEs has grown considerably, and the concentrated use of benchmarks and the directional co-movement of investor flows can generate correlated investment patterns that may create one-sided markets and exacerbate price fluctuations. Indeed, we provide evidence showing that, during the past two years, investor flows to asset managers and EME asset prices have reinforced each other's movements.

JEL classification: G11, G15, G23.

In recent years, asset managers have become important players in emerging market economy (EME) asset markets. This shift has coincided with a prolonged period of very low interest rates in advanced economies, which has led investors to look for higher-yielding (but riskier or less liquid) assets in the hope of greater returns. This has resulted in a sharp rise in bond issuance by EME entities, especially EME corporations.

Increased foreign investment in EME assets can boost investment and growth in EMEs and help develop their financial markets. But this comes at a price. Successive crises have shown that foreign investors may destabilise EME asset markets – accentuating both booms and busts. For example, during the latest period of turbulence, which started in May 2013, large capital outflows from many EME bond markets drove up bond yields and led to a sharp depreciation of EME currencies. This increased the cost to EME borrowers repaying foreign currency debt and exposed, in particular, EME corporations to refinancing risks (Chui et al (2014)).

In this article, we find that asset managers in EME asset markets tend to behave in a correlated manner and that investment flows to asset managers and asset prices amplify each other's fluctuations. In particular, we first show that asset managers have increased their presence in EMEs over the past decade. Second, the use of common/similar portfolio benchmarks and the directional co-movement of ultimate investor flows can generate correlated investment decisions by asset managers. Moreover, we provide evidence showing that, during the past two years, investor flows to asset managers and EME asset prices reinforced each other's

[1] The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS. We are grateful to Claudio Borio, Michael Chui, Hervé Hannoun, Soyoung Kim, Madhusudan Mohanty, David Ng, Frank Packer, Sergio Schmukler, Hyun Song Shin and Christian Upper for discussion and comments. We also thank Tracy Chan, Steven Kong, Jimmy Shek and Agne Subelyte for research assistance.

directional movements. It is therefore important that policymakers understand how actions by asset managers and their ultimate investors can potentially destabilise EME asset markets.

Global asset managers in EME asset markets

Global investors are generally interested in holding EME assets but often do not want to or cannot hold them directly, which leads them to rely on asset managers to access these markets. In particular, retail investors typically invest in collective investment vehicles, managed by a small number of large asset management companies (AMCs). Institutional investors also invest in such vehicles or use separate (segregated) accounts managed by AMCs. As delegated investors, asset managers perform an agency function for these investors, who are the ultimate owners of the assets. Revenues of AMCs largely come from the fees they charge their clients for investment services.

Collective investment vehicles[2] offer different fund structures and allocation strategies to investors (Table 1). There are two main fund structures: open-end and closed-end funds. Open-end funds allow investors to add or redeem investments. Exchange-traded funds (ETFs) are a form of open-end fund that is traded on exchanges. Closed-end funds, when set up, issue a fixed number of shares that are traded on secondary markets. Open-end mutual funds and ETFs are larger than closed-end funds in terms of both the number of funds and the total amount of assets under management (AUM).

Types of collective investment vehicles investing in bonds and equities[1] Table 1

	Bond funds investing in:		Equity funds investing in:	
	Advanced economies	Emerging market economies	Advanced economies	Emerging market economies
Fund structure				
Open-end mutual funds	90.9	91.5	83.9	72.9
Closed-end mutual funds	2.2	1.1	0.9	1.8
Exchange-traded funds	6.9	7.3	15.2	25.3
Investor				
Institutional[2]	50.8	55.0	48.4	62.4
Retail	48.6	44.7	50.8	37.2
Strategy				
Actively managed	85.7	92.8	69.3	69.5
Passively managed	14.2	7.2	30.7	30.5

[1] The share of total net assets as of end-May 2014, in per cent. [2] In the EPFR database, institutional investor funds are defined as funds targeting institutional investors only or those with the minimum amount of $100,000 per account.

Sources: EPFR; authors' calculations.

[2] Terminologies differ by country. For instance, open-end funds are called mutual funds in the United States and UCITS (undertakings for collective investment in transferable securities) in the European Union. In this article, we use the term "mutual funds" for collective investment vehicles, which include traditional open- and closed-end funds managed by AMCs, but not hedge funds.

Asset managers can also be divided into two types by investment strategy. The first is actively managed funds, whose allocation or investment decisions are not tied directly to a benchmark index. The second is passively managed funds, which seek to mirror or closely track the performance of a particular benchmark index. Table 1 shows that around 70–90% of the EME assets managed by collective investment vehicles have mandates to follow an active investment strategy. That said, the share of passively managed funds including almost all ETFs has increased in recent years, particularly following the 2008 financial crisis. Most notably, owing to their low cost, ETFs have gained popularity among investors interested in EME assets.

The size and concentration of the global asset management industry have increased over the past decade. First, as ultimate investors' assets continue to grow, the total amount of AUM by the largest 500 AMCs doubled from $35 trillion in 2002 to almost $70 trillion in 2012 (Graph 1, left-hand panel).[3] Many AMCs saw large declines in AUM following the collapse of Lehman Brothers in 2008, which some observers attributed mainly to valuation effects, rather than redemptions. But as markets rebounded, so did AUM.

Second, the global asset management industry is dominated by a small number of large players. In 2012, the share of the largest 20 AMCs was about 40% of the total AUM of the largest 500 companies, or $28 billion (Graph 1, left-hand panel). Furthermore, the top five accounted for 18% of total AUM, with the largest player representing nearly 6% of the total.

To gauge the activity of asset managers in EMEs, we rely on the commercial database of mutual funds and ETFs provided by Emerging Portfolio Fund Research (EPFR) Global.[4] This is one of the most widely used data sources of foreign fund flows to EMEs, owing partly to the high frequency of the data. The data are typically used to track retail and institutional investment flows. That said, the individual institutional investors represented by the EPFR data are believed to be relatively small in size compared with those that use the major global custodians.[5] Therefore, the EPFR institutional flows may not be a very good proxy for the entire universe of institutional investment flows.

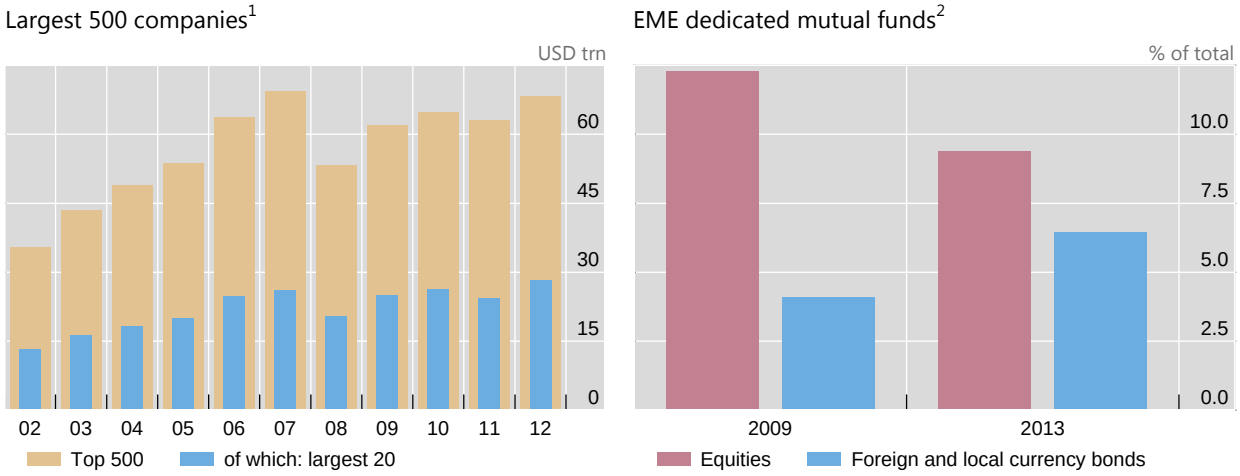
EPFR data indicate that the AUM of dedicated EME funds have grown strongly. The total AUM of EME equity and bond funds increased from the pre-Lehman peak of $900 billion in October 2007 to $1.4 trillion in May 2014 (or about 8.5% of total EME equities and bonds outstanding). In particular, the total AUM of EME equity funds increased from $702 billion at the end of 2009 to $1.1 trillion at the end of 2013, and those of EME bond funds quadrupled from $88 billion to $340 billion over the same period.

[3] The total includes AMCs which are either independent or owned by banks or insurers. Also included are some independent hedge funds, which represent only a small share. Of the top 20, nine AMCs were bank-owned, eight independent and three insurer-owned. In some cases, an institution's total assets could be larger than those under its asset management function.

[4] As of end-May 2014, the total amount of AUM by mutual funds and ETFs in the EPFR database globally amounted to about $23 trillion. EPFR Global collects data on total net assets and flows by investor (retail and institutional), country and asset type. The database covers some 11,000 equity funds and about 4,500 fixed income funds, among others. The coverage of EME assets is generally not very comprehensive, and particularly weak for EME bonds.

[5] EPFR Global defines institutional investor funds as funds targeting institutional investors only or those with the minimum amount of $100,000 per account.

Asset management industry: size, concentration and allocation to EME assets Graph 1



[1] Not all of them are asset managers; see footnote 3 in main text. [2] All EPFR funds.

Sources: EPFR; Towers Watson; authors' calculations.

The picture is more mixed when it comes to the share of EME funds in all mutual funds and ETFs. The share allocated to EME bonds (foreign currency and local currency) rose from 4.1% to 6.4% (Graph 1, right-hand panel). By contrast, the share of EME equity funds out of the total AUM of all equity funds declined from 12.3% to 9.4% over the same period. But these changes are likely to reflect valuation effects. During 2009–13, major EME bond indices outperformed advanced economy (AE) bond indices by about 10% in US dollar terms, accounting for some of the sharp increase in allocations to EME local currency bonds. Meanwhile, major EME equity price indices underperformed their counterparts in AEs by about 30% in US dollar terms. After accounting for these changes, allocations to EME equities may well have risen.

The large size and concentration of AUM of asset managers in relatively small and illiquid EME asset markets are a potentially important source of concern. Any decision by asset managers with large AUM to change portfolio allocation can have a major impact on EME asset markets that are relatively small. For instance, a 1 percentage point reallocation of AUM of the largest 500 AMCs discussed above, the total size of which amounts to about $70 trillion, would result in additional portfolio flows of $700 billion to EMEs.[6] This is larger than the very large amounts of gross portfolio outflows in 2008 ($246 billion) and inflows in 2012 ($368 billion) documented in IMF (2014). The implication could be more significant in smaller and more open economies than in those with larger but less open financial systems.

Correlation of investment in EME assets by asset managers

Whether or not asset managers have a destabilising effect on markets depends in large part on how correlated their behaviour is. There are two broad channels through which asset managers might behave very similarly to each other. The first

[6] The estimated $700 billion may be considered as an upper bound to the extent that many of the funds are located in advanced economies and are likely to trade EME assets in offshore markets.

channel is described in the first subsection below entitled "Use of benchmark indices", which deals with mechanisms within the asset management industry that may induce correlated behaviour. We mainly focus on the use of common/similar benchmarks, while touching upon other key mechanisms, such as relative and short-horizon performance evaluation. The second channel is treated in the following subsection entitled "Ultimate investor flows", which discusses the behaviour of ultimate investors, who may commit to or redeem funds simultaneously, thus forcing asset managers to buy or sell.

Use of benchmark indices

Benchmarks play critical roles for asset managers. Conceptually, there are three different levels upon which we can consider the impact of benchmarks on correlations. First, at the individual fund level, a fund's management style (active or passive) given a benchmark matters. The more active a fund is, the less closely the portfolio weights of the fund follow those of its benchmark. Second, at the level of the asset management industry, the use of common benchmarks and correlation between benchmarks is of importance. Asset managers will behave more similarly if many of the assets are tied to the same benchmark or if the benchmarks themselves are correlated. Finally, the method used for constructing benchmark indices can be a source of increased volatility.[7] This subsection focuses on the first and second aspects, while the third is discussed in the box.

How active are actively managed EME mutual funds?

For passively managed funds, including ETFs, the link between fund allocation and a benchmark is direct. Although passive managers do not perfectly replicate their benchmark index because of transaction costs,[8] they have very little leeway to deviate from their benchmark. As a consequence, the larger the number of passively managed funds indexed to a particular benchmark, the more correlated these funds are. When ultimate investors, say, withdraw their money, passively managed funds will sell portfolios in similar fashions, aggravating directional price movements.

But the use of benchmarks also gives rise to correlated behaviour on the part of actively managed funds. The managers of such funds tend to be evaluated by whether the returns of their investments match or exceed those of a particular benchmark index. Although active managers do not necessarily fully replicate the portfolio weights of the benchmark, the career risk of short-term underperformance against their peers can induce them to form similar portfolios or to "hug" their benchmarks as tightly as possible. This would increase the correlation of asset managers' portfolio choices. Morris and Shin (2014) and Feroli et al (2014) formalise this point.

[7] Ultimate investors typically use market capitalisation-weighted indices as benchmarks for evaluating fund manager performance. This follows from the efficient markets hypothesis that market portfolios constitute optimal, minimum-risk portfolios. But since component securities can easily be mispriced in reality, investors may be putting most money in overpriced securities and least in undervalued ones (Woolley and Vayanos (2012)). This practice tends to amplify price distortions and in turn distort the benchmark itself.

[8] Passively managed funds typically aim to track the performance of benchmark indices by using so-called "representative sampling techniques", and thus do not hold all the securities in a benchmark index.

In order to measure the degree of activism of an EME bond fund, we calculate the active share as the sum of the absolute value of deviations of the fund's country weights from those of the benchmark, following Cremers and Petajisto (2009):

$$Active\ Share_i = \frac{1}{2}\sum_{c=1}^{N}|w_{ic} - w_{ic}^{B}|.$$

If a fund replicates a benchmark, the portfolio weight of country c in fund i, w_{ic}, will be equal to the weight of that country in the benchmark, w_{ic}^{B}, giving an active share of zero. A fund's active share of 10% means a 90% overlap with the benchmark.

We focus on actively managed global and regional EME bond funds which use JPMorgan bond indices as benchmarks and have monthly data on fund portfolio country weights available from the EPFR database from January 2011 to June 2014. We consider 17 EMEs (Brazil, Chile, China, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, Nigeria, Peru, the Philippines, Poland, Romania, Russia, South Africa and Turkey) individually, and lump the other countries in a residual category.

Table 2 summarises the sample of bond funds used for our analysis and reports the average and median value of their active share by type of fund. There are four types by geographical coverage: global EME (70 funds), Asia ex-Japan (two funds), emerging Europe (one fund) and Latin America (two funds). The average and median values of the active share are largest for global EME local currency bond funds and smallest for regional EME bond funds. Also, global EME local currency bond funds have a greater degree of activism than global EME hard currency (ie foreign currency) bond funds.[9]

To formally measure the degree of activism of these funds, we conduct panel regression analysis following the empirical approaches in Raddatz et al (2014). In addition to considering all 75 EME bond funds, we classify them into the following three categories based on the active share: "closet index" funds[10] with an active share between 0% and 10%, "weakly active" funds with a share between 10% and 20%, and "strongly active" funds with a share greater than 20%.

Active share of actively managed global and regional EME bond funds — Table 2

	Number of funds	Number of benchmarks	Average value of the active share	Median value of the active share
Global EME local currency bond	28	3	17.7	17.3
Global EME hard currency bond	31	4	15.3	14.1
Global EME mixed currency bond	11	4[1]	12.8	10.8
Regional EME bond[2]	5	4	9.1	9.6
Total	75	11	15.4	14.2

[1] All benchmarks in this category overlap with those for global EME local currency and hard currency bond funds. [2] Includes two Asia ex-Japan, one emerging Europe and two Latin America funds. In the EPFR database, no currency breakdown is available for these funds.

Sources: EPFR; JPMorgan Chase; authors' calculations.

[9] The active shares at the security level could be higher. Unfortunately, we were not able to compute them owing to data limitations.

[10] A closet index fund is an asset management fund that claims to actively manage its portfolio but in reality emulates a benchmark index.

In particular, we consider the following three empirical specifications:

$$w_{ict} = \theta_{ic} + \theta_{it} + \alpha_1 w^B_{ict} + \varepsilon_{ict} \quad (1)$$

$$w_{ict} = \theta_{ic} + \theta_{it} + \alpha_1 w^B_{ict} + \alpha_2 w^M_{ict} + \varepsilon_{ict} \quad (2)$$

$$w_{ict} = \theta_{ic} + \theta_{it} + \alpha[w^B_{ict-1}(R_{ct}/R^B_{it})] + \beta E^B_{ict} + \varepsilon_{ict}. \quad (3)$$

Specification (1) is the baseline specification, which shows how closely w_{ict}, a fund i's weight of country c at time t, follows the fund's benchmark weight, w^B_{ict}. Specification (2) considers, in addition to benchmark weights, the median peer weight, w^M_{ict}, of each group of funds. The greater the extent to which fund managers follow their peers due partly to relative performance evaluation, the higher the coefficient on the median peer weight. Specification (3) is a variation of specification (1), which gauges the impact of two separate components of the benchmark weight, w^B_{ict}: (i) the buy-and-hold component, $w^B_{ict-1}(R_{ct}/R^B_{it})$, where R_{ct} and R^B_t are the return on a country's bond and that on the benchmark, respectively; and (ii) the exogenous component, E^B_{ict}, capturing changes in benchmarks due to new bond issues, upgrades or downgrades, and addition to or deletion from certain indices on the one hand, and changes in the benchmark construction methodology on the other.

Table 3 shows that country weights of EME bond funds tend to follow their benchmark weights quite closely. In particular, when we consider the benchmark weight only (specification (1)), the estimated coefficient is 0.87 for the whole

Panel regressions of fund country weight on benchmark weight

Table 3

Benchmark weight and median peer weight								
	Total (75)		Closet index (16)		Weakly active (41)		Strongly active (18)	
Benchmark weight	0.87***	0.87***	0.95***	0.96***	0.94***	0.93***	0.65***	0.64***
	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	(0.09)	(0.09)
Median peer weight		0.45***		–0.03		0.42***		0.40***
		(0.06)		(0.11)		(0.07)		(0.14)
Observations	35,015	35,015	4,721	4,721	20,499	20,499	9,795	9,795
R-squared	0.80	0.81	0.92	0.92	0.88	0.89	0.66	0.66

Buy-and-hold and exogenous components of benchmark weights				
	Total (75)	Closet index (16)	Weakly active (41)	Strongly active (18)
Buy-and-hold component	0.87***	0.95***	0.94***	0.64***
	(0.04)	(0.04)	(0.04)	(0.09)
Exogenous component	0.72***	0.62***	0.83***	0.99***
	(0.20)	(0.24)	(0.29)	(0.27)
Observations	34,053	4,628	19,912	9,513
R-squared	0.81	0.93	0.88	0.66

Explanatory variables not reported here include fund-country fixed effects and fund-time fixed effects. Median peer weight is the median weight for a country at a point in time among all bond funds in each category. Panel estimation does not contain observations where both fund country weight and benchmark weight are zero. Standard errors are in parentheses. The errors ε_{ict} are clustered at the benchmark-time level. */**/*** denotes statistical significance at the 10/5/1% level.

Sources: Raddatz et al (2014) (for regression specifications); EPFR; JPMorgan Chase; authors' calculations.

sample, and the coefficient decreases as the degree of activism increases.[11] In specification (2), the coefficient on the median peer weight is statistically significant and its size is about half that of the benchmark weight. This is consistent with the hypothesis of the peer industry effect.[12] Finally, when the buy-and-hold and exogenous components of the benchmark weight are considered separately (specification (3)), we find that the coefficient on the buy-and-hold component for strongly active EME bond funds is smaller than that on the exogenous component. This result implies that these funds react more strongly to the exogenous changes in benchmark weights than to market value-driven changes in benchmark weights.

Concentrated use and correlation of benchmarks

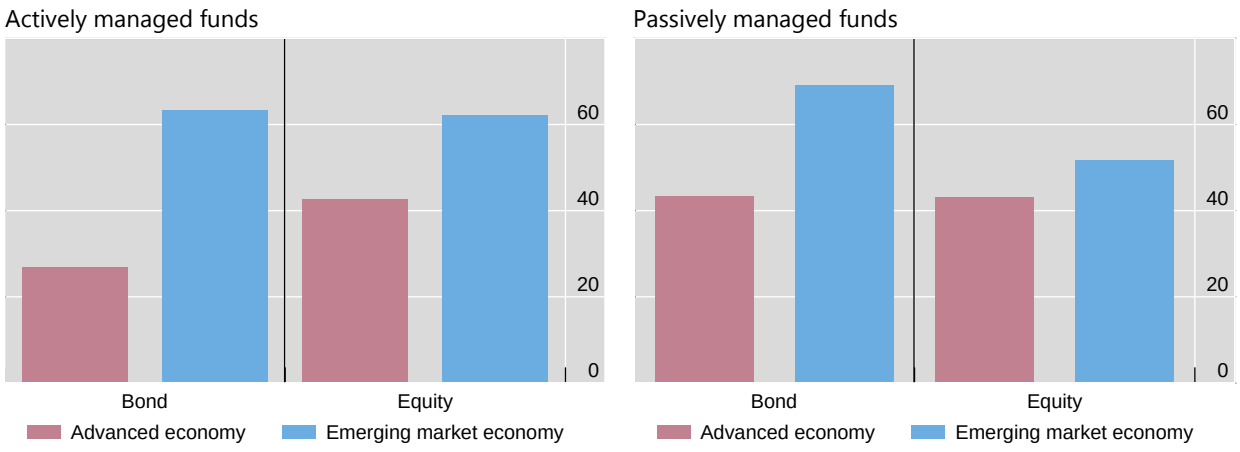
At the asset management industry level, the use of common benchmarks by many EME asset funds and correlation between their benchmarks can lead them to adopt similar asset allocation strategies. These funds are likely to move in the same direction and react in similar ways when they face EME-related shocks.

Mutual funds and ETFs investing in EME assets tend to have less diverse benchmarks than those investing in AE assets, in part because there are fewer benchmark indices available. Graph 2 shows that the share of AUM linked to the top five benchmarks is larger for each category of EME funds than for the corresponding category of AE funds. Graph A in the box shows the list of these benchmarks for the eight categories in Graph 2.

But even if asset managers benchmark their performance to different indices, benchmarking may induce correlation if the indices themselves are correlated. This may be because benchmark providers use similar methodologies in constructing

Share of top five benchmarks used by bond and equity mutual funds and ETFs

As of end-May 2014, as a percentage of total net assets — Graph 2



Sources: EPFR; authors' calculations.

[11] It is difficult to judge whether a coefficient of 0.87 means a high degree of passivity in absolute terms. However, the coefficient on the benchmark weight in a similar regression analysis conducted by Raddatz et al (2014) for all global and regional AE and EME bond funds over a different sample period is greater than that reported in Table 3. Therefore, we can infer that global and regional EME bond funds tend to follow their benchmarks more closely than global and regional AE bond funds.

[12] The coefficient on the median peer weight for closet index funds is statistically insignificant because the country weight used by the median fund is very similar to that of the other funds in the group.

Measuring the degree of similarity between two benchmark indices Table 4

Index pair	Overlap[1]	Index pair	Overlap[1]
JPMorgan GBI-EM Broad index (20)[2] – Barclays Emerging Markets Local Currency Government Universal Bond index (25)[2]	72	JPMorgan GBI-EM Broad index (20)[2] – redefined Barclays Emerging Markets Local Currency Government Universal Bond index (20)[3]	81
JPMorgan GBI-EM Global index (17)[2] – Barclays Emerging Markets Local Currency Government Bond index (22)[2]	62	JPMorgan GBI-EM Global index (17)[2] – redefined Barclays Emerging Markets Local Currency Government Bond index (17)[3]	85

[1] In per cent. $Overlap_t^{B1,B2} = 1 - \frac{1}{2}\sum_{c=1}^{N}|w_{ct}^{B1} - w_{ct}^{B2}|$. [2] Figures in parentheses are the number of countries in each index with at least one positive value of monthly country weights since January 2011. [3] To make the JPMorgan index and Barclays Capital index comparable, we exclude five countries not included in the former from the latter, and recalculate the weights for the remaining countries in the Barclays Capital index.

Sources: Barclays Capital; JPMorgan Chase; authors' calculations.

indices or because benchmark indices tend to comprise the whole range of investable assets rather than a smaller subset. To formally examine the correlation across indices, we use the definition of the active share to calculate how similar two indices from different benchmark providers are between January 2011 and June 2014. Table 4 shows that comparable global EME local currency bond indices provided by JPMorgan Chase and Barclays Capital have more than an 80% overlap.

The low share of activism, the high concentration in the use of benchmarks and the strong correlation between benchmarks introduce a high degree of similarity in the behaviour of asset managers investing in EME assets. In the next subsection, we show that the behaviour of ultimate investors adds to this correlation.

Ultimate investor flows

The co-movement of inflows from ultimate investors to mutual funds is another important source of correlation of asset managers' investments. Retail investors, in particular, tend to move their investments in the same direction most of the time. To arrive at this finding, we count the number of bond funds that faced weekly net inflows or outflows each week from January 2013 to June 2014 for retail and institutional investors. We find that retail investors have a tendency to buy (Graph 3, left-hand panels, red bars) or sell (yellow bars) at the same time.[13] The direction switched from net inflows to outflows in June 2013, and the degree of co-movements remained high up to the first quarter of 2014. There appears to be less co-movement on the part of institutional investors (Graph 3, right-hand panels). A large number of institutional investors pulled out their funds in June 2013, but the number of funds experiencing inflows and outflows has since remained relatively balanced.

The finding that retail investors in particular behave very similarly to each other is not specific to EME funds, as can be seen from the similarity between the top and bottom panels of Graph 3. What is different is the volatility of the share of funds facing inflows or outflows, which is greater for EME funds than for AE funds.

[13] We consider global EME, global ex-US, global and US-North America bond funds with investor flow information over the 78 weeks available in the EPFR database. There are 1,610 retail investor funds in these four categories of bond funds out of 2,371 retail investor funds, and 1,510 institutional investor funds in these four categories out of 2,196 institutional investor funds.

Emerging market benchmarks

To measure concentration in the use of benchmarks of EME asset funds, we identify a benchmark index adopted by each fund and then aggregate the AUM of all funds using the index. Graph A shows that EME equity and bond funds are more concentrated than their AE counterparts in their use of benchmarks. For example, two JPMorgan EMBI Global indices are used for 38% of the total AUM of actively managed EME bond funds in the EPFR database, while two Barclays Capital bond indices are used for 20% of the total AUM of actively managed AE bond funds.

Given the wide use of a small number of benchmark indices, their construction and composition are crucial. Major indices have been created by broker-dealers. Indices such as Morgan Stanley's MSCI equity indices, JPMorgan Chase's EMBI and GBI bond indices and Barclays Capital's bond indices are typically constructed on the basis of tradability, liquidity, credit rating and valuation criteria. Under these criteria, an issuer with a larger amount of marketable securities receives a larger index weight. Other weighting schemes are also used. For example, Barclays Capital offers bond indices that weight countries by GDP or fiscal strength.

As an illustration, the EME share in the global equity and bond indices is much smaller than their GDP share. In particular, in the MSCI All Country World Index (ACWI), which includes 23 major AEs and 21 major EMEs, the EME share is 10%. This contrasts with the GDP share of 36% of the same 21 EMEs out of the total GDP of the 44 economies (Table A). The same is true for the JPMorgan GBI Broad index for 27 AEs and the JPMorgan GBI-EM Broad index for 18 EMEs. When we combine these two indices, the EME share is 6%, while their GDP share is 32% (Table B).

AE-EME shares of MSCI indices and nominal GDP

Table A

	MSCI index market cap[1]	Share[2]	Nominal GDP[1, 3]	Share[2]
Advanced economies (23)[4]	32,427[5]	90	42,881	64
Emerging market economies (21)[6]	3,7907[7]	10	23,628	36
Total	36,2178[8]	100	66,509	100

[1] In billions of US dollars, as of 30 April 2014. [2] In per cent. [3] Retrieved from the IMF WEO database as of April 2014. [4] Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong SAR, Ireland, Israel, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom and the United States. [5] MSCI World Index. [6] Brazil, Chile, China, Chinese Taipei, Colombia, the Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Russia, South Africa, Thailand and Turkey. [7] MSCI Emerging Markets Index. [8] MSCI All Country World Index.

Sources: IMF; MSCI; authors' calculations.

Recently, index providers have become progressively more independent. As an example, for the Markit iBoxx ABF indices, Markit collects prices from multiple sources, controls for quality and then computes an average of the price on a daily basis. Moreover, in October 2012, the market weights of the Markit iBoxx ABF indices were adjusted to consider the following three factors: local bond market size (20%), sovereign local debt rating (20%) and the GEMLOC Investability Indicator (60%).① In July 2010, Pacific Investment Management Company (PIMCO) also launched two GDP-weighted sovereign bond indices (PIMCO Global Advantage Government Bond Index and European Advantage Government Bond Index) using the individual Markit country components.

AE-EME shares of JPMorgan GBI indices and nominal GDP

Table B

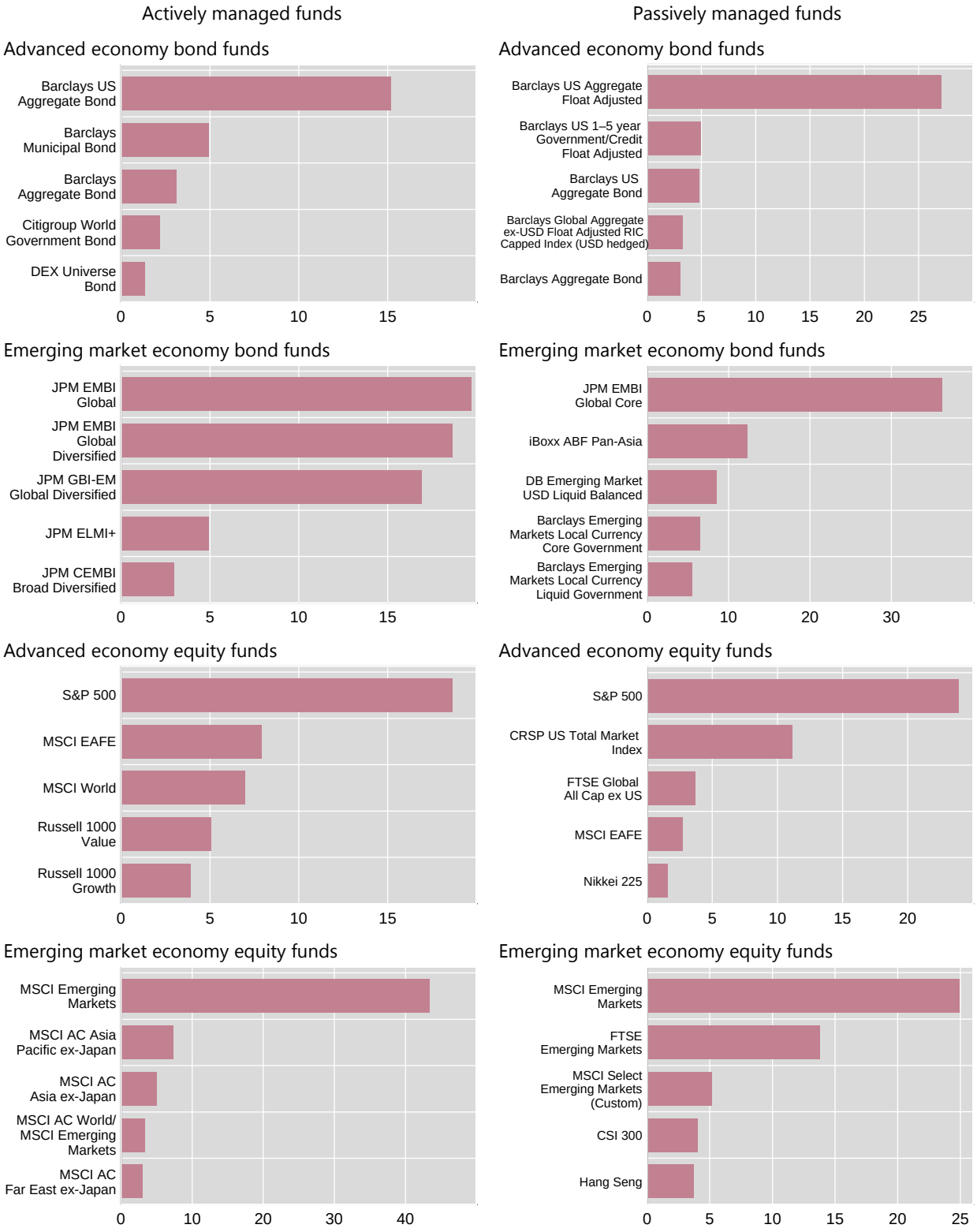
	GBI index market cap[1]	Share[2]	Nominal GDP[1, 3]	Share[2]
Advanced economies (27)[4]	24,031[5]	94	45,397	68
Emerging market economies (18)[6]	1,549[7]	6	21,681	32
Total	25,580[8]	100	67,079[8]	100

[1] In billions of US dollars, as of 30 April 2014. [2] In per cent. [3] Retrieved from the IMF WEO database as of April 2014. [4] Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Hong Kong SAR, Hungary, Ireland, Israel, Italy, Japan, Korea, Mexico, the Netherlands, New Zealand, Poland, Portugal, Singapore, Spain, South Africa, Sweden, the United Kingdom and the United States. [5] GBI Broad index. [6] Brazil, Chile, China, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, Nigeria, Peru, the Philippines, Poland, Romania, Russia, South Africa, Thailand and Turkey. [7] GBI-EM Broad index. [8] Hungary, Mexico, Poland and South Africa are included in both the GBI Broad and GBI-EM Broad indices. The total size of the four countries in terms of GBI Broad market capitalisation is $383 billion (1.5% of the total), and that of the four countries in terms of nominal GDP is $2,257 billion (3.4% of the total).

Sources: IMF; JPMorgan Chase; authors' calculations.

Key benchmarks used by bond and equity mutual funds and ETFs

As of end-May 2014, as a percentage of total net assets — Graph A



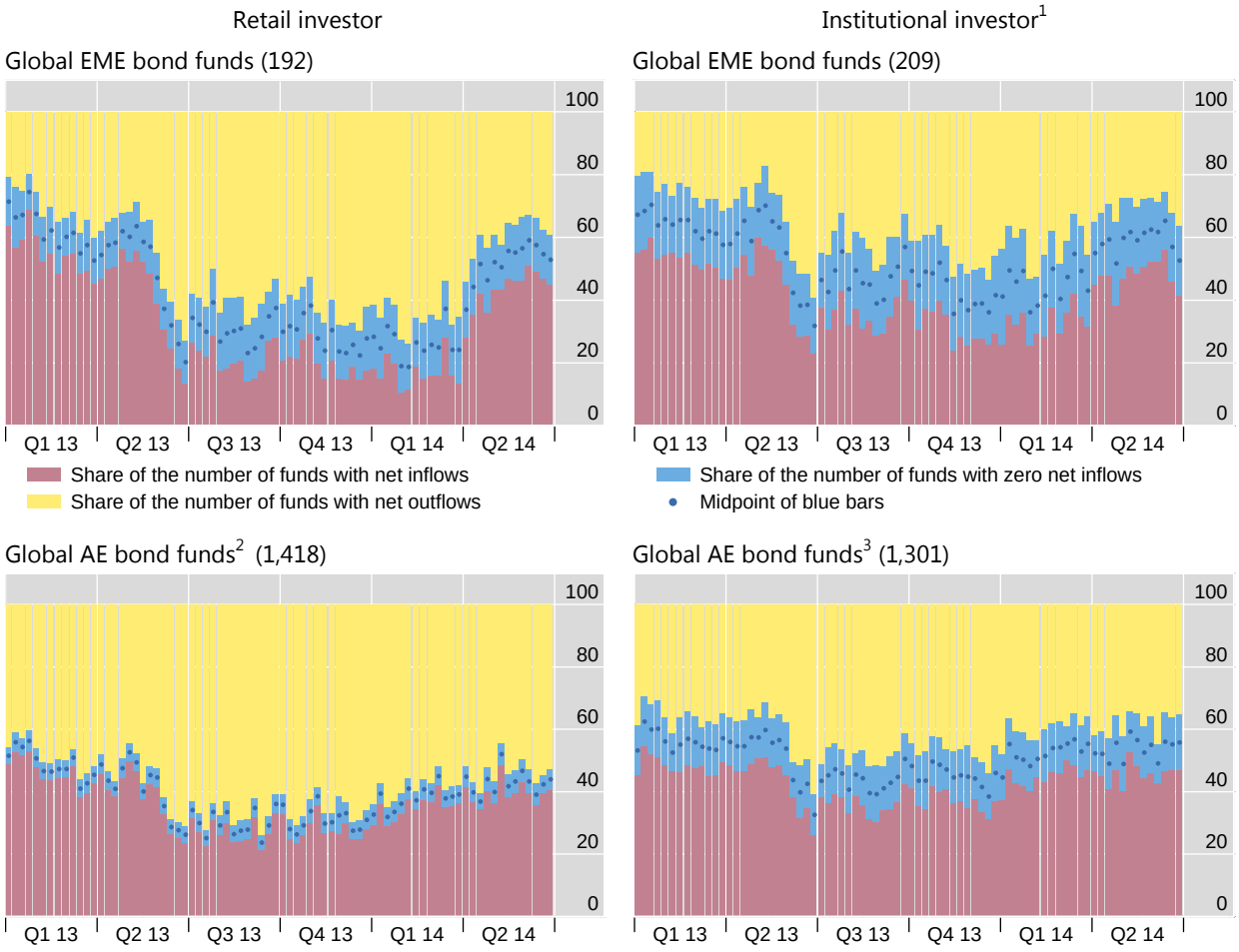
Sources: EPFR; authors' calculations.

① The GEMLOC Investability Indicator is a measure of accessibility to foreign investors based on a methodology developed by the World Bank. The indicator scores a market on a set of 14 subfactors that are aggregated to the overall score.

We support this conclusion through more formal statistical analysis using a clustering measure à la Lakonishok et al (1992).[14] In particular, we first divide the number of global AE and EME bond funds facing net inflows in a given week by the number of funds facing either net inflows or outflows, and use the ratio as the expected share of funds facing inflows in that week. Then, we calculate the 95% confidence interval around the expected share under a binomial distribution for that week.[15] We calculate this interval for each of 78 weeks to control for common

Behaviour of ultimate investors of global AE and EME bond funds

January 2013 to June 2014, weekly data, as a percentage of the total number of funds in each category — Graph 3



Figures in brackets represent the number of funds in each category.

[1] In the EPFR database, institutional investor funds are defined as funds targeting institutional investors only or those with the minimum amount of $100,000 per account. [2] Global ex-US funds, global funds and US-North America bond funds.

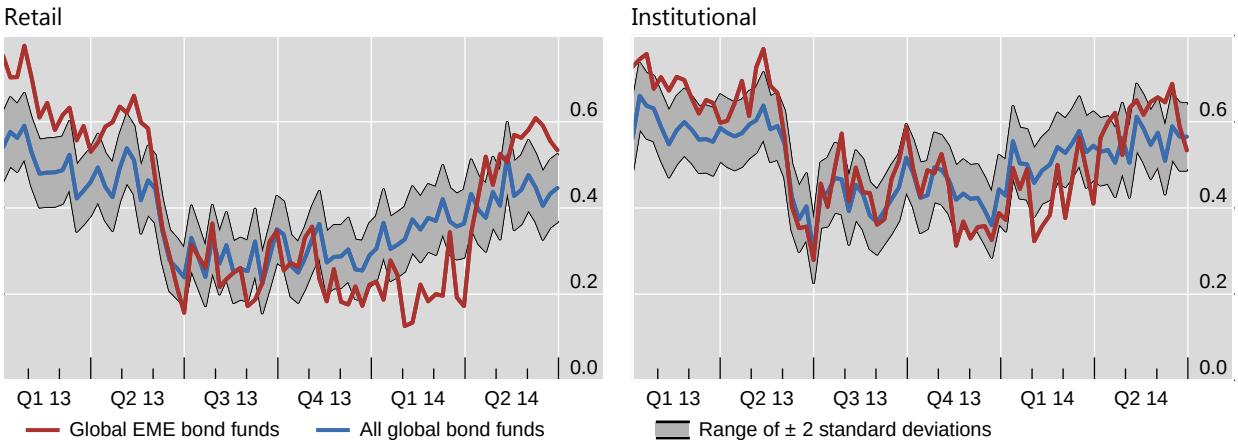
Sources: EPFR; authors' calculations.

[14] As pointed out by Cipriani and Guarino (2014), we present indirect evidence of informational herding in financial markets through a statistical measure of clustering. This measure cannot distinguish between spurious herding (eg the result of a common reaction to EME-specific news) and true herding (ie the decision to disregard one's private information to follow the behaviour of others).

[15] For binomial distribution $B(n, p)$, n is the total number of global EME bond funds facing either net inflows or outflows, and p the expected share of global AE and EME bond funds facing net inflows.

Measuring investor clustering in global EME bond funds

Share of the number of funds facing net inflows out of that facing net inflows or outflows — Graph 4



Sources: EPFR; authors' calculations.

shocks on inflows to all global bond funds each week. Finally, we check each week if the specific share of global EME bond funds lies within this interval.

We find that retail investor flows exhibit clustering more often than institutional investor flows. In particular, the left-hand panel of Graph 4 shows that the share of global EME bond funds facing net retail investor inflows falls outside the 95% confidence band in 49 out of the 78 weeks throughout the sample period. The right-hand panel shows that institutional investor flows display similar patterns, although investor clustering is both less frequent (30 out of 78 weeks) and less severe.

Investor behaviour during recent bouts of market turbulence

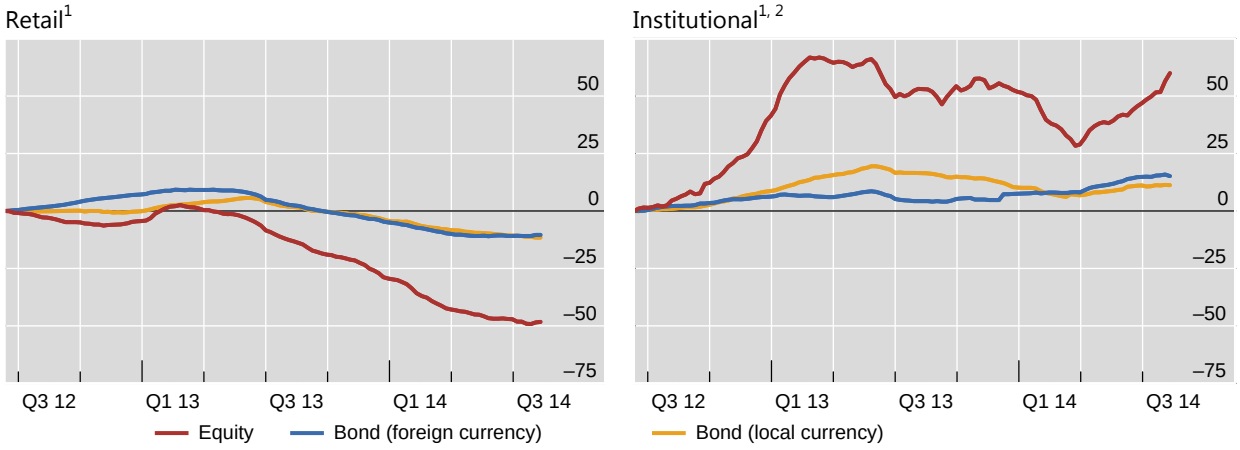
In this section, we analyse the behaviour of ultimate investors during the recent episodes of financial market volatility. We examine two dimensions of investment behaviour: whether investment flows to EME assets have differed between retail and institutional investors, and whether these investment flows and the related asset returns have been procyclical, ie have reinforced each other's movements. It should be noted that, as discussed in the previous section, correlated behaviour on its own does not lead to procyclicality.

On the first dimension, the data summarised in Graph 5 suggest that retail and institutional investors behave differently. The left-hand panel shows that retail investors have moved their money out of mutual funds and ETFs dedicated to EME equities since the first quarter of 2013, and out of those dedicated to EME bonds since May 2013. By contrast, the right-hand panel shows that institutional investors withdrew less than retail investors, even though they adjusted their net exposure in a more volatile manner. Moreover, data from the large global custodians suggest that relatively large institutional investors have held onto, and even increased, their holdings of EME assets during the same period (IMF (2014)).

Cumulative net inflows to EME equity and bond funds

In billions of US dollars

Graph 5



[1] All EPFR funds. [2] EPFR Global defines institutional investor funds as funds targeting institutional investors only or those with the minimum amount of $100,000 per account.

Sources: EPFR; authors' calculations.

The second dimension is whether investment flows to EMEs can be a source of cyclical instability. If investors move funds into EME asset markets by chasing returns, inflows would increase in response to domestic asset price and exchange rate appreciation. Such inflows could create procyclical flow-price dynamics if, in response, domestic asset prices and exchange rates appreciated further.

To shed some light on this question, we estimate a small vector autoregressive (VAR) model. It allows us to capture the dynamic interaction between variables relying on a minimal number of assumptions about the overall model structure. The VAR model can be used to compute the typical response over time of one variable to unforecastable changes ("surprises") in other variables.

Our VAR model includes two endogenous variables – cumulative net inflows and US dollar-denominated total returns.[16] The latter variable's movements can be due to those of domestic asset prices and/or exchange rates. We do not attempt to disentangle the two effects. The model is estimated by investor type (retail and institutional) for each type of EME asset (equities, foreign currency bonds and local currency bonds) using weekly data that span the period from June 2012 to early August 2014.

Our results suggest that both retail and institutional investor flows to EME assets, and the total returns on these assets in US dollar terms, are generally procyclical. For instance, a one standard deviation surprise rise in equity returns in US dollar terms raises both retail and institutional equity flows by a similar magnitude.[17] The effect is statistically significant. The response of equity returns to a one standard deviation surprise increase in equity flows is also significantly

[16] The data are expressed in terms of weekly percentage changes. Flows are assumed to be slower-moving than total returns. That is, flows do not react contemporaneously to prices but prices can react contemporaneously to flows.

[17] Equity flows increase by about 0.5% and gradually fall back to the baseline after a few weeks.

positive for both retail and institutional investors.[18] We obtain broadly similar results for foreign currency and local currency bond flows.

Taken at face value, these results do not conform to the view that institutional flows are relatively less procyclical than retail flows because institutional investors internalise the negative consequence of trading due to their larger market share (Chen et al (2010)). One possible explanation is that, as mentioned above, the individual institutional investors represented by EPFR data are relatively small in size – therefore similar to retail investors – compared with those that use the major global custodians.

Conclusion

In this article, we have argued that the asset management industry could potentially be a source of vulnerabilities for EME asset markets. In particular, there is a higher degree of concentration in the use of benchmarks by asset managers investing in EME assets than by those investing in AE assets. Also, we find more clustering in ultimate investor flows in EME assets than in those in AE assets. These factors can increase the correlation in the behaviour of asset managers and, under certain conditions, raise the potential for one-sided markets in EMEs. Indeed, during the past two years, investor flows to asset managers and EME asset prices reinforced each other's movements.

The possibility that asset managers and their ultimate investors destabilise EME asset markets is obviously highly relevant for policymakers. The current prudential regulation of the asset management industry mainly focuses on microprudential and consumer protection aspects and does not really address any issues that give rise to correlated behaviour across asset managers or the procyclicality of investor flows and asset prices. Understanding these macroprudential aspects would be an important step towards monitoring vulnerabilities created by asset managers and designing an effective policy response.

[18] Returns increase by about 1.5% and revert to the baseline after one week.

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Risks related to EME corporate balance sheets: the role of leverage and currency mismatch[1]

Corporates in many EMEs have taken advantage of unusually easy global financial conditions to ramp up their overseas borrowing and leverage. This could expose them to increased interest rate and currency risks unless these positions are adequately hedged. The key question is whether EME corporate balance sheets have become more susceptible to shocks. Greater corporate exposures could, in turn, spill over into vulnerabilities for both local banks and the financial system more broadly. Shocks to interest or exchange rates could generate damaging feedback loops if credit risk concerns were to prevent existing bank or bond market funding from being rolled over.

JEL classification: D21, F31, G32.

Very low yields in advanced countries post-crisis have triggered huge investment flows into emerging market economies (EMEs), thanks to their brighter growth prospects. While these capital inflows have brought economic benefits, they could make EMEs more vulnerable to external shocks if unchecked surges in credit and asset prices were to raise the spectre of renewed boom-bust cycles (BIS (2014), Chapter IV). Events in May 2013 and early 2014, for example, suggest that large cross-border capital movements could cause considerable volatility in EME asset prices and exchange rates, with implications for growth and financial stability (see eg Avdjiev and Takáts (2014)).

In this environment, the financial exposures of EME non-financial corporations, in particular, could have wider implications. Debt issuance in foreign currencies exposes these borrowers to rollover and foreign currency risks. If such risks materialise, the creditworthiness of some corporations could worsen, pushing up bond yields. Higher financing costs and tighter funding conditions for firms could then become a drag on economic growth. Higher bond yields would also inflict losses on holders of EME corporate debt, which include local banks and other investors, such as global asset managers. Balance sheet pressure on corporations could also subject banks and other intermediaries to funding stresses, as firms are forced to withdraw their deposits. All in all, such developments could generate

[1] The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS or the CGFS. We are grateful to Claudio Borio, Dietrich Domanski, Mathias Drehmann, Masazumi Hattori, Ulf Lewrick, Hyun Song Shin, Philip Turner, Christian Upper and the participants of the Joint CGFS – FSB-SCAV workshop in Hong Kong SAR on risks from currency mismatches and leverage on corporate balance sheets for useful comments and discussions, and we thank Branimir Gruić, Mario Morelli and Jhuvesh Sobrun for their expert research assistance.

powerful feedback loops in response to exchange rate shocks if credit risk concerns mean that existing bank or bond market funding is not rolled over.

Against this background, this article examines the risks related to EME corporate balance sheets and their possible implications for the broader financial system. To set the scene, the first section below reviews recent patterns in corporate non-financial sector borrowing and the rising importance of cross-border financing flows for EME corporates. On this basis, the second section then asks whether corporate balance sheets have become more vulnerable. The third section discusses the possible financial stability implications, followed by a short conclusion.

Recent patterns in corporate non-financial sector borrowing

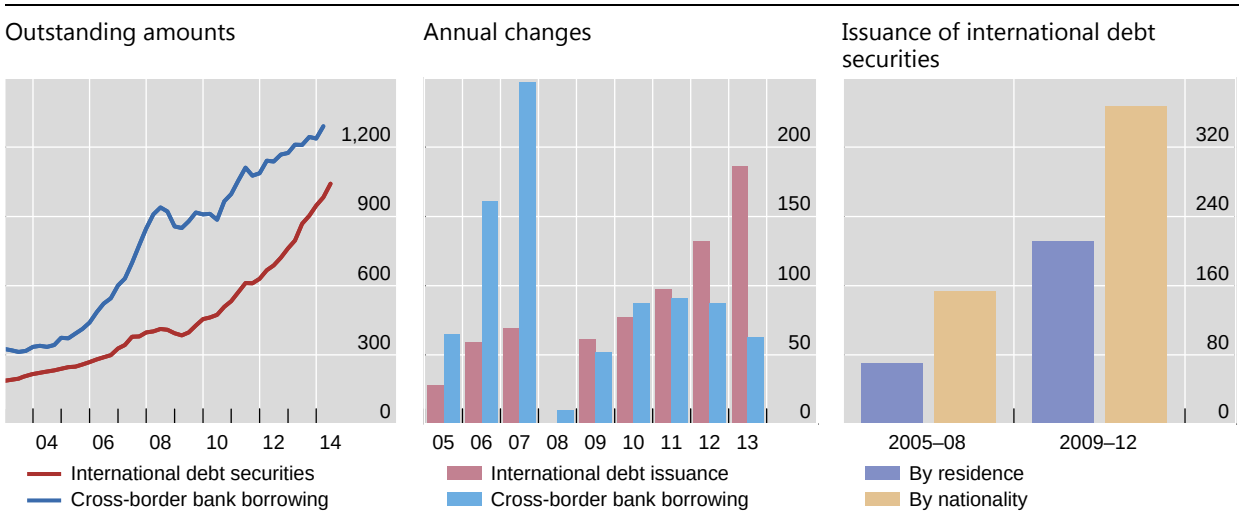
In recent years, EME non-financial corporations have seen growing incentives and opportunities to increase leverage, by borrowing in both foreign and domestic currencies. The drivers include low interest rates and compressed term premia, broad appreciation trends underpinning key emerging market currencies post-crisis, and better access for EME borrowers to international markets.[2]

Developments in cross-border credit are particularly noteworthy. Although bank claims still account for the largest share of outstanding cross-border credit for

EME private cross-border bank borrowing and international debt issuance[1]

In billions of US dollars

Graph 1



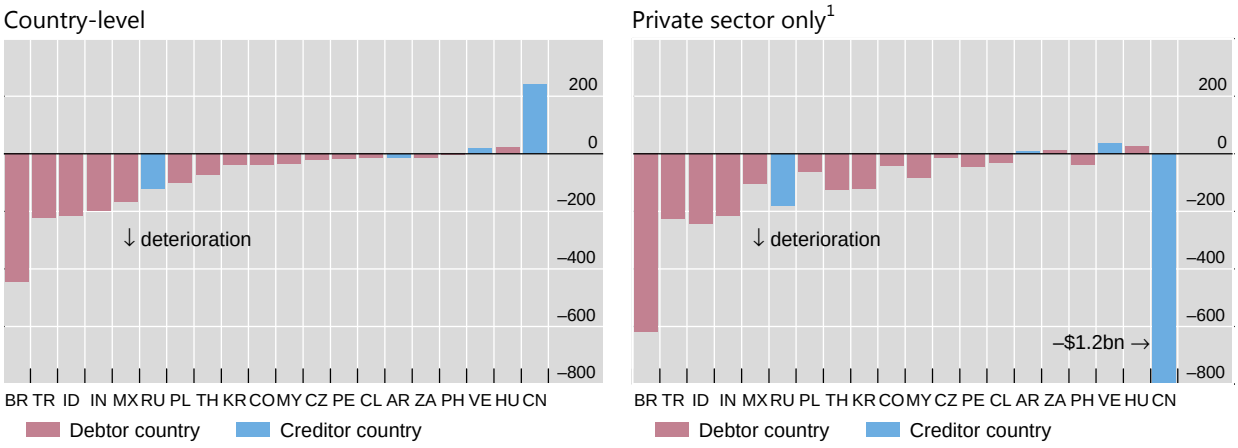
[1] Private non-bank sector. Cross-border bank borrowing (by residence) also includes claims on the household sector and claims on portfolio debt investment (implying a degree of double-counting), while international debt issuance (by nationality) includes securities issued by non-bank financials and non-financial corporations; and these securities could be denominated in local or foreign currency.

Source: BIS consolidated banking statistics and international debt securities statistics.

[2] In this article, unless otherwise stated, the term "EME" is to be read as referring to the following 21 major emerging market economies: Argentina, Brazil, Chile, China, Chinese Taipei, Colombia, the Czech Republic, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Russia, Turkey, South Africa, Thailand and Venezuela. Note that Hong Kong SAR and Singapore are excluded from this group of EMEs, as many corporates headquartered in developed and other emerging countries have raised funds there, which could blur the analysis of debt issuance by residence and nationality in our study.

Changes in net international investment positions

Between end-2008 and end-2012, in billions of US dollars — Graph 2



AR = Argentina; BR = Brazil; CL = Chile; CN = China; CO = Colombia; CZ = Czech Republic; HU = Hungary; ID = Indonesia; IN = India; KR = Korea; MX = Mexico; MY = Malaysia; PE = Peru; PH = Philippines; PL = Poland; RU = Russia; TH = Thailand; TR = Turkey; VE = Venezuela; ZA = South Africa.

[1] Derived by excluding all official sector (government and central bank) components from the total net international investment position.

Source: IMF, Balance of Payments Statistics.

the private non-bank sector (Graph 1, left-hand panel), a key feature of the past few years has been the strong growth of international debt issuance by non-financial sector corporates (Graph 1, centre panel). This stands in contrast to the pre-crisis period (see eg Shin (2013)).

In aggregate, a significant part of the international debt of these EME corporates is issued through their overseas subsidiaries (Graph 1, right-hand panel). Issuance data based on issuer nationality (including issuance by the overseas subsidiaries of the corporations headquartered in a given country) indicate that private sector borrowers (other than banks) in major EMEs issued international debt securities worth almost $375 billion in 2009–12, more than double their issuance in the four-year period prior to the crisis.[3] Issuance in 2013 was also strong, even though there were signs late in the year that global bank claims were recovering too.

The scale and overall importance of recent developments in EME corporate and wider private sector financing are also apparent from broader indicators of external financing, such as international investment positions (IIPs). Many EMEs have seen their net external positions shift considerably since 2008 (Graph 2, left-hand panel). Comparison of the private sector contributions (Graph 2 right-hand panel) with country-level IIP changes reveals that the observed decline in net IIP balances was primarily driven by rising private sector liabilities (including those of corporates), whereas official sector balances have been stable or rising. Note, however, that IIP

[3] The issuer by nationality concept is similar to the consolidated claims concept in the BIS international banking statistics. It is especially important in the case of EMEs such as Brazil and China where local corporates have increased their issuance of international debt via overseas subsidiaries – including non-bank financing vehicles. By contrast, the issuer by residence concept does not include issuance by these overseas subsidiaries, but it does include international debt issues by other nations' subsidiaries residing in the respective country.

data are derived from residence-based statistics and usually do not include the gross positions of overseas subsidiaries; nor do they cover domestic positions.[4]

Potential risks to the corporate sector

A key question is whether these developments have made EME corporates more vulnerable – for example, to the combined effects of a slowdown in the domestic economy, currency depreciation and rising interest rates globally. Such risks are accentuated when leverage starts to loom too large relative to borrowers' debt servicing capacity or when foreign currency assets or revenues are insufficient to match large foreign currency liabilities. Rising interest rates and depreciating exchange rates will tend to raise the cost of servicing these debts, denting profits or depleting capital cushions, unless appropriate hedges are in place.

Unfortunately, data limitations mean that such vulnerabilities are notoriously hard to assess, especially in a cross-country context. For many EMEs, the lack of financial accounts data at the national level means that internationally comparable measures of corporate sector leverage are difficult to obtain. In what follows, selected metrics are used to provide at least a partial picture.

Corporate leverage

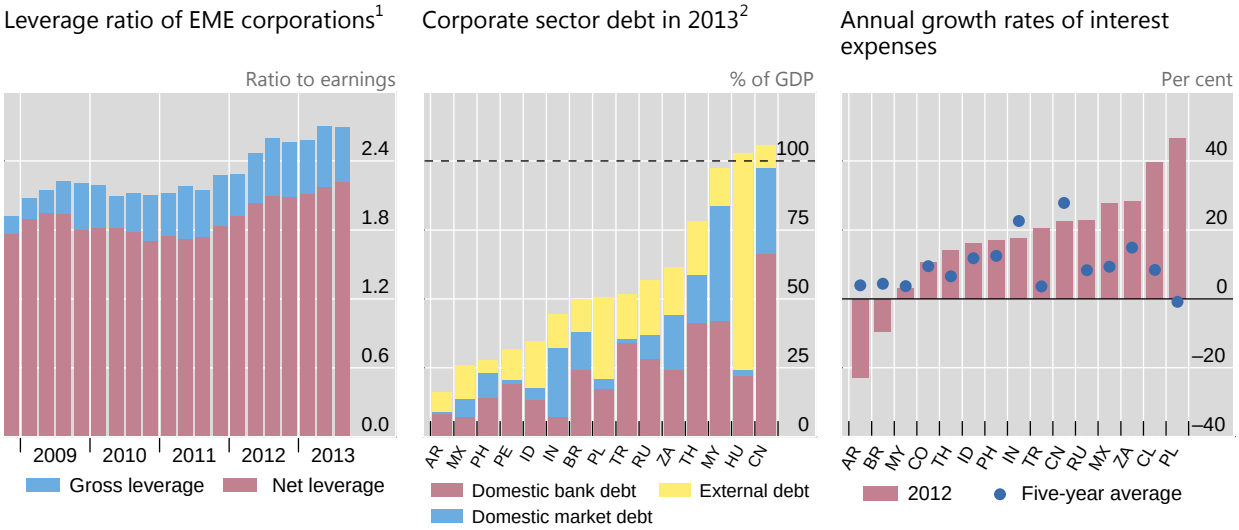
Various measures point to rising leverage on corporate balance sheets. One such indicator is the debt/earnings ratio as disclosed by individual firms. A recent study, based on a sample of non-financial corporations from seven large EMEs, suggests a more or less steady increase in corporate leverage over the last few years (Graph 3, left-hand panel).[5] Country-level data (based on residence) on corporate debt-to-GDP ratios appear to confirm this trend, while providing a perspective on broad leverage levels across jurisdictions. According to this metric, corporate indebtedness now hovers at around 100% of GDP for some EMEs (Graph 3, centre panel). Yet, despite recent trend growth, levels vary considerably between countries and remain modest by international standards.

Borrowing patterns have differed across countries in recent years. While developments in some economies (eg for corporates in Latin America) appear to reflect a more general shift from primarily domestic to more internationally diversified funding sources (Powell (2014)), in others domestic debt rose in tandem with external borrowing. For example, Chinese corporates (especially property developers) now appear to be quite highly leveraged, at least in comparison with their EME peers, and may find it challenging to manage these debt levels in an environment of slowing growth and tightening profit margins (Bank of America Merrill Lynch (2014)).

[4] Over the past few decades, many Chinese companies have opted for a listing in overseas stock markets (Hong Kong SAR in particular) to raise capital and hone their corporate governance. As of end-June 2014, nearly 300 Chinese-owned or affiliated companies were listed on the main board of the Hong Kong stock exchange with an aggregate market capitalisation of $660 billion.

[5] See Bank of America Merrill Lynch (2014). BIS (2014), Chapter VI, provides additional information based on capitalisation ratios.

EME corporate balance sheets: selected metrics Graph 3



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[1] Firm-level data from S&P Capital IQ for 900 companies in seven EMEs; simple average across countries; gross leverage = total debt/earnings; net leverage = (total debt – cash)/earnings. [2] External debt includes liabilities from affiliates, direct investments and other sources.

Sources: IMF, *Global Financial Stability Report*, April 2014; Morgan Stanley; BIS calculations.

Debt/earnings ratios can also reveal how rising leverage may be affecting the capacity of firms to service their debts. A recent analysis based on firm-level data finds that corporate debt grew faster than earnings in one third of the sample economies between 2008 and 2012.[6] For Brazil, China and India, the average firm required 2.5 to three years of current annual gross earnings to repay its debt in 2012, compared with two to 2.8 years in 2008. In many cases, the deterioration in debt servicing capacity reflects a combination of rising debt loads and slowing earnings growth. Furthermore, despite broadly stable and low interest rates over the past five years, many EMEs have encountered a sharp increase in interest expenses because of the larger debt loads (Graph 3, right-hand panel).

Asset composition

The nature or quality of assets acquired using the newly borrowed funds may either strengthen or weaken a firm's resilience against external shocks. Evidence on the use of newly raised corporate funds is mixed. On the one hand, there are signs that capital expenditure (capex) has been on the rise. Analyst estimates suggest that the average capex of EME corporates (which includes funds used to upgrade production capacity and acquire physical assets) has increased by almost one third over the past few years, based on a sample of 120 EME corporate issuers.[7] In this context, the stronger earnings prospects associated with capital spending would tend to offset at least part of the risks associated with rising leverage.

[6] See IMF (2014), which compares median corporate debt loads with earnings across 18 EMEs to gauge the corporate sector's debt servicing capacity.

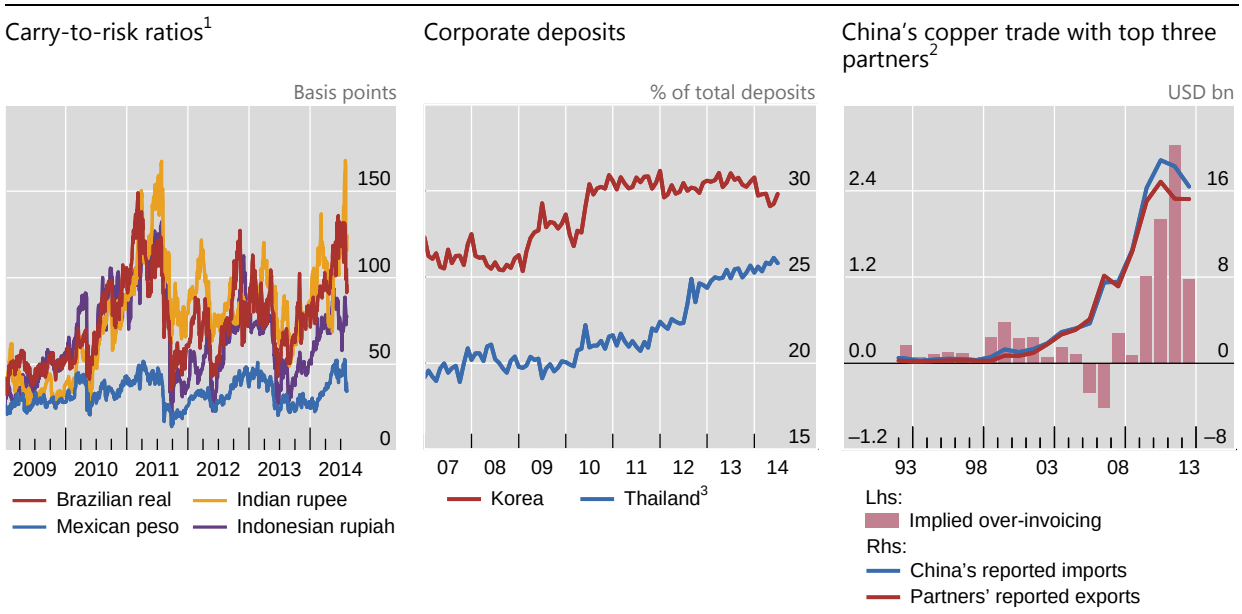
[7] See Bank of America Merrill Lynch (2014).

On the other hand, due to low volatilities, Sharpe ratio-type risk-adjusted return metrics (eg interest rate differentials adjusted for exchange rate volatility) suggest that carry trade incentives are also strong (Graph 4, left-hand panel), which may have tempted some corporate treasurers into more speculative activities.

One indicator of such activities may be corporate cash holdings, as measured by the difference between gross and net leverage ratios, which have increased markedly since 2009 (Graph 3, left-hand panel). Similarly, corporate bank deposits have grown in a number of banking systems during this period (Graph 4, centre panel). The fact that the trend has not abated more recently suggests that post-crisis caution may not be the only reason why firms have increased their cash holdings. This is in line with reports that corporates in some jurisdictions were seeking to take advantage of international interest rate differentials by borrowing overseas and depositing the proceeds in local banks, subscribing to money market mutual funds or purchasing high-yielding wealth management products.[8] In Korea, for example, deposits by private non-financial companies in trust companies and their shares in investment funds rose by a respective 36% and 45% in the two years to end-2013. In China, reports of over-invoicing by Chinese importers have emerged, especially for metals and other high value-to-density articles (Graph 4, right-hand panel). The low-cost funds raised through trade financing for these imported articles are reportedly being used for both business investment and

Carry trade incentives, corporate deposits and over-invoicing

Graph 4



[1] One-month interest rate differentials, adjusted for implied volatility of the respective currency pairs; base currency: US dollar. [2] Bilateral trade of copper and articles thereof (international code: HS74) between China and the world's top three copper producers: Australia, Chile and the United States; over-invoicing is defined as the difference between imports and corresponding bilateral exports. [3] For corporate deposits, business deposits.

Sources: IMF, *Balance of Payments Statistics*; UN Comtrade database; Bank of America Merrill Lynch; Bloomberg; JPMorgan Chase; BIS calculations.

[8] According to official data, the total balance of banks' wealth management products in China rose from CNY 2.3 trillion in late 2009 to almost CNY 10 trillion in late 2013; see *Financial Times* (2014).

speculation.[9] Yet the overall scale of these activities is difficult to judge, and even normal treasury operations could well lead to a substantial rise in local currency deposits at the local banks (eg due to time-to-build and similar constraints).

Increased bond market financing

A related issue concerns the composition of funding sources and, in particular, the rising share of bond market financing. As highlighted above, strong investor interest has underpinned EME corporate bond markets in recent years. If investors were to suffer a significant loss of appetite, issuing firms might face difficulty in rolling over their outstanding debts, particularly if shifts in risk appetite coincide with a fall-off in projected earnings.

Many of the recent EME corporate borrowers have gained access to the debt markets, both domestic and international, for the first time. The willingness of investors to let these issuers roll over their debt in adverse circumstances is thus untested. BIS international debt securities data, which exclude domestic as well as short-term issuance, suggest that the rollover needs of corporates from major EMEs and their overseas subsidiaries will rise from around $90 billion in 2015 to a peak of $130 billion in 2017–18 (Gruić et al (2014)).[10] Note that these figures may underestimate the risk of a sudden retreat by global investors, who may also hold the domestic debt of EME corporates. For some corporations, rising debt repayments will be particularly taxing in an environment of US dollar strengthening (see below) and slowing domestic activity. Also, while domestic banks continue to be the dominant source of funding for EME corporates, their ability and willingness to help refinance market debt may be limited, particularly if risk appetite is on the wane.

Currency mismatch

Given the elevated levels of foreign currency borrowing, currency mismatches represent another possible source of vulnerability. Recent developments in Ukraine are a reminder of how abruptly debt sustainability metrics can deteriorate when (in this case, geopolitical) risks undercut the exchange rate, thus inflating the local currency value of foreign currency liabilities. This raises the question of how far the foreign exchange risks of rising foreign currency liabilities at EME corporates are either financially hedged or naturally matched by foreign currency asset returns and revenues.[11]

[9] For example, the World Gold Council (2014) estimates that, by the end of 2013, "surplus" gold linked to financial operations in the Chinese shadow banking system could have reached a nominal value of nearly $40 billion. See also Goldman Sachs (2013) for a detailed exposition of the mechanics involved in the copper "carry trade".

[10] International issuance, which is dominated by US dollar-denominated debt, makes up about one fifth of total debt issuance, with domestic debt accounting for the remainder. Domestic debt will add to interest rate and rollover risks, but does not usually incur a currency mismatch risk (as covered in more detail below).

[11] Data on country-level foreign currency exposures and on how far they are hedged are generally unavailable. Australia is an exception in that the Australian Bureau of Statistics conducts a Foreign Currency Exposure Survey to gauge the country's net foreign asset position (ie after taking into account the hedging of foreign currency exposures using financial derivatives) (see Rush et

In the absence of more specific information on natural hedges, issuer sectors may serve as an important proxy indicator. Commodity producers and manufactures exporters, for example, earn much of their revenues in foreign currencies and are thus likely to weather the rising debt service costs associated with currency depreciation better than would issuers with mostly domestic incomes (eg domestic telecoms, construction companies and utilities).

On this basis, a cursory examination of firm-level issuance data suggests that non-financial borrowers from countries such as Brazil, Mexico, Russia and South Africa would be more likely to have at least partially matching foreign currency assets and liabilities, given the predominance of commodities producers and exporters among the largest issuers. In contrast, assets and liabilities are less likely to be matched at property developers in China or energy and utilities firms in India, which have been among the more active international debt issuers in recent years, pointing to possible "pockets of risk" in these sectors.

Companies can also manage their foreign currency exposures via derivatives. Again, reliable data on corporate hedging activities are generally scarce, while incentives to take open interest rate and foreign currency hedging positions have been relatively strong recently. One issue is hedging cost and, hence, the depth of the relevant hedging market. This might suggest that corporates from countries such as Brazil, Korea or Mexico (which are known to have access to liquid domestic or offshore markets that support financial hedging strategies for both currency and interest rate risk exposures) are more likely to be hedged than their peers in, say, China or Indonesia. Indeed, data for Mexico indicate that the volume of exchange rate derivatives transactions picked up sharply from a monthly average of around $12 billion in 2007–08 to more than $25 billion in late 2013, in line with the observed increase in local corporates' international issuance. In countries with less developed markets, however, mismatches will often go unhedged because markets may not be deep enough to provide appropriate and cost-effective hedging.[12]

The flip side of this argument is that derivatives-related financial exposures can change the sensitivity of corporate balance sheets in ways that may be unrelated to what is suggested, say, by the issuer's sector. In the early stages of the global financial crisis, for example, some large corporates in Brazil, Korea and Mexico experienced significant losses because of largely speculative positions in foreign exchange derivatives contracts (see box). This experience shows that an abrupt change in the exchange rate trend can conspire with complex financial exposures to wreak significant damage on corporate balance sheets even when a firm's foreign exchange liabilities are deemed to be adequately hedged during normal times.

An additional concern is that liquidity in hedging markets can evaporate during times of market stress. Even longer-term exposures are often hedged with more liquid short-term contracts with the aim of reducing hedging costs. As the respective contracts have to be rolled over regularly, this could significantly reduce the value of financial hedges against large exchange rate fluctuations, since markets are bound to be at their shallowest when hedging needs are greatest. In this

al (2013)). Yet the Survey is conducted infrequently (once every four years) and is residence-based (as opposed to nationality-based).

[12] For illustration, the 2013 annual report of one large Chinese property developer states: "The Group manages its currency risk by closely monitoring the movements of currency exchange rates. The Group currently does not have a currency hedging policy [...] but will consider hedging significant currency exposure should the need arise."

Currency derivatives and corporate losses: this time is different?

The Lehman bankruptcy in September 2008 triggered a global shortage of US dollar funding, lifting the US currency. According to one estimate, the ensuing sharp depreciation of local currencies against the dollar hit 50,000 or more non-financial corporations with total losses of at least $30 billion, via positions on foreign exchange (FX) derivatives contracts.① This added to the uncertainty in those corporates' domestic financial markets, worsening the impact of the crisis still further. Given that many EME corporations are said to have increased their foreign exchange exposures significantly in recent years, a key question is how vulnerable such firms are to, possibly abrupt, exchange rate movements. This box reviews some key features of the derivatives activities of EME corporations in 2008, and highlights differences between then and now.

One factor behind EME corporates' foreign exchange losses in 2008 was the popularity of contracts with a "knock-in, knock-out" (KIKO) feature. Heavy use of such contracts meant that many exporters, while insured against modest exchange rate movements, were exposed to possibly large losses if the local currency depreciated sharply.

In a standard FX option transaction, a company (eg an exporter) with revenues mostly in foreign currency (eg in US dollars) but with production costs in local currency buys, for a small fee (premium), a put option from a counterparty (eg a local bank) that gives the exporter the right but not the obligation to sell its dollar income at a specific strike price at a future time. If the domestic currency spot exchange rate at maturity is stronger than the agreed rate, the exporter exercises the option and gets a higher income in local currency terms than it would otherwise get at the spot rate.

Compared with this basic setup, KIKO contracts have two additional features. The first is a call option (knock-in) held by the bank. If the reference currency (eg the US dollar) strengthens beyond a certain threshold, the knock-in requires the exporter to sell its dollars at the strike price (ie below market rates). The second, so-called knock-out, feature dictates that no option can be exercised by either the exporter or the bank if the dollar weakens below a certain threshold. Both features serve to reduce hedging expenses, albeit at the cost of retaining the tail risk of stronger currency depreciations.

A third feature is possible acceleration effects. KIKO contracts were quite often leveraged (at, say, 1:2), resulting in payments that would double the contractual amounts. This resulted in open speculative positions on relatively stable exchange rates. Furthermore, some EME corporations apparently purchased multiple KIKO contracts with different banks to bypass each individual bank's counterparty limit. As a result, when the US dollar rose sharply against almost all currencies in late 2008, these corporations suffered "unexpected" losses owing to the knock-in feature in their hedging operations.

Given the risk of high potential losses, a key question is why so many EME corporations used KIKO or similar contracts to hedge their FX exposures prior to 2008. There are a number of possible explanations. By design, KIKO features lower the premium charged by the contract seller. In that sense, many EME corporations were attracted by the low hedging costs. This feature was particularly attractive at the time, as the major EME currencies had experienced a long period of slow but steady appreciation against the US dollar. The resulting false sense of security was reinforced by most commercial and official forecasts, which, up until 2007, called for this trend to continue in the near term. Furthermore, local banks were often not the actual seller of the KIKO contracts, but merely acted as intermediaries for foreign banks and ultimate investors, such as hedge funds. In doing so, banks earned a fee while passing the exchange rate risk on to the ultimate contract sellers. Under such circumstances, banks may have had an incentive to sell more contracts to increase their fee income, at least insofar as their client relationships with their corporate customers were not jeopardised by any losses that their clients might incur.

Against this background, an important difference between now and then is that the recent prolonged period of relatively low volatility in foreign exchange markets has been punctuated by the two "tapering" events, in May 2013 and January/February 2014. No major losses from corporate exposures in derivatives markets were revealed in the aftermath of these episodes. That said, carry trade incentives have since strengthened again, and certain EME corporations may have incurred exposures via contracts that will generate losses only at a later stage. For example, there is anecdotal evidence of increased interest from Asian corporates in structured foreign exchange products with KIKO-like features. In addition, for some EME hedging markets, the sellers of hedging products are often concentrated and the markets themselves are not very liquid. Again, this tendency could exacerbate any market reaction once the market changes direction.

① See eg Sidaoui et al (2010) and Lee (2009).

context, the May 2013 and early 2014 episodes of sharp currency depreciation in many EMEs may have served as wake-up calls, by inducing corporate treasurers to review and trim any open currency exposures. Recent attempts by the Chinese authorities to introduce more two-way risk into renminbi exchange rates would seem work in the same direction.

Implications for local banks and the financial system

What are the implications of more vulnerable EME corporate sector balance sheets for the financial system? Scope for spillovers arises from at least two channels, as detailed below.

Liability-side exposures

One channel works through the liabilities of banks and, possibly, other financial institutions.[13] Among these, local institutions are likely to be particularly exposed, especially if they have come to rely on corporate deposits for part of their wholesale funding. For deposits that are associated with corporates exploiting the "carry" between local and foreign currency interest rates, the unwinding of such positions when interest rate differentials narrow or volatilities increase will reduce these funds. Deposits that are denominated in foreign currencies, in turn, are known to be more procyclical than other types of deposits and may thus be subject to sudden withdrawals by corporates facing rollover risks (Turner (2014)).

A key factor in the transmission of such effects is the shadow banking system. In Korea, for example, assets held by non-bank financial institutions have grown at an annual average rate of 10% since the global financial crisis. Securities companies, in particular, have seen their assets increase more than twofold during that period. In this context, it appears that the securities sector in Korea has accumulated substantial claims on banks and other depository institutions. Securities firms, in turn, finance themselves with short-term money market instruments held by the non-financial corporate sector. To the extent that non-financial corporates issue debt but hold the proceeds as liquid claims, they behave as surrogate intermediaries channelling funding from global capital markets into the domestic financial system (Bank of Korea (2014)).

Asset-side exposures

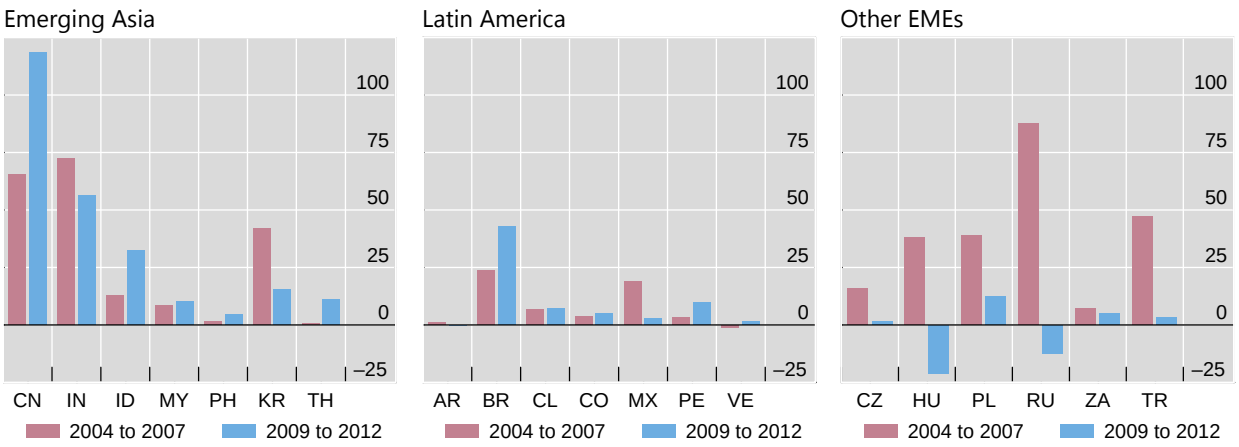
Another, more conventional, channel is the risks embodied in asset-side exposures. Banks tend to have direct credit exposures to corporates via lending and through counterparty risk from any derivative positions. While these exposures can be important internationally, for example vis-à-vis Asia (Graph 5), local banks, again, tend to be particularly exposed, with loans to non-banks still accounting for a large part of domestic loans in many jurisdictions. Furthermore, since larger and more creditworthy corporates have better access to cross-border borrowing, higher foreign bank penetration could end up increasing the exposure of local lenders to

[13] See Chung et al (2014) for a discussion of how the financial activities of non-financial corporates in international markets could affect funding conditions and credit availability in home markets.

Changes in global banks' foreign claims on EME non-bank private sector[1]

In billions of US dollars

Graph 5



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[1] Not adjusted for exchange rate movements.

Source: BIS consolidated banking statistics.

smaller, possibly less creditworthy, firms. That said, a mitigating factor is that standard on-balance sheet leverage and capitalisation metrics for EME banks tend to be rather favourable in the aggregate, which may help to reduce such risks at the banking system level.[14]

Another, less direct, source of credit risk for banks comes from broader exposure to debt markets, eg via bond holdings. Recently, however, there have been signs that asset managers and other buy-side investors have increasingly displaced bank investors in corporate bond markets. This raises questions about feedback effects if existing positions are not rolled over (see below).

Feedback effects

Working together, both types of channel can give rise to potentially powerful feedback effects. Currency mismatches, for example, will tend to amplify both default risk and pressure to deleverage if borrowers are hit by a depreciating local currency. Combined with uncertainties about the true extent of such mismatches, concerns about rising default risk could then result in a more widespread rout of international investors, loss of market access and spillovers into domestic interbank markets – exacerbating the financial and macroeconomic impact of the initial interest rate or foreign exchange shock.

The duration risk exposures of asset managers and other institutional investors (the flip side of corporates' attempts to issue new debt and term out existing borrowings) are another potential source of adverse price dynamics. These might be further amplified by the correlated behaviour of asset managers. Such herding in bond markets can arise from the reliance on common risk management

[14] A possible caveat is that EME and advanced country bank balance sheet metrics may, in fact, be converging; see CGFS (2014) and BIS (2014), Chapter VI, for details.

technologies, from simultaneous buy and sell decisions due to index tracking, and from a rush to exit due to concerns about market liquidity.[15]

Conclusions

Unusually easy global financial conditions post-crisis and the ubiquitous quest for yield have encouraged EME non-financial corporations to increase leverage and overseas borrowing. In many jurisdictions, corporates have opted to lock in low global interest rates and to sharply increase their international debt issuance. While cheap funding could boost economic performance if it supports viable investment projects, it inevitably increases the borrower's interest rate, rollover and currency risks. Furthermore, some EME corporations may have used borrowed funds for purely financial (ie speculative) purposes. In other cases, these external positions may be inadequately hedged, whether through natural offsets or by the use of financial instruments.

Overall, these factors have increased the risks facing these companies, implying the existence of "pockets of risk" in particular sectors and jurisdictions. If these risks were to materialise, adding to broader EME vulnerabilities (BIS (2014)), stress on corporate balance sheets could rapidly spill over into other sectors, inflicting losses on the corporate debt holdings of global asset managers, banks and other financial institutions. This could be a source of powerful feedback loops in response to exchange rate and/or interest rate shocks, especially if credit risk concerns prevented the rollover of existing bank or bond market funding.

[15] For a more detailed exploration of the risks arising from the increased participation of global asset management companies in emerging markets, see Miyajima and Shim (2014). Kamada and Miura (2014) provide a model and empirical evidence of herding by bond market investors in Japan due to some of the same factors.

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Cross-border bank lending during the taper tantrum: the role of emerging market fundamentals[1]

Cross-border bank lending to emerging markets slowed sharply during the taper tantrum. The abruptness of this slowdown varied considerably across both lenders and borrowers. We use newly available data to explain the drivers of this cross-sectional variation. Although the initial tapering shock originated from advanced economies, EME-specific factors explain the bulk of the variation in the slowdown across lender-borrower pairs.

JEL classification: F34, G15, G21.

Starting with the Federal Reserve's May 2013 hint that it might begin reducing its bond purchases sooner than previously expected, the "taper tantrum" triggered sharp drops in the exchange rates of emerging market economies (EMEs) as well as in their bond and equity prices. While the sharp reversal in portfolio flows to EMEs has been widely documented, the behaviour of cross-border bank lending has received less attention. This is surprising given the importance of cross-border bank lending for most EMEs: the outstanding stock of cross-border bank claims on EMEs stood at more than $3.6 trillion at the end of 2013 – roughly as large as the stock of all portfolio investment in EMEs. Thus, notwithstanding the growing importance of securities market financing, a sudden stop in cross-border bank lending could still destabilise economies and, in the worst case, lead to a balance of payments crisis.

During the taper tantrum, cross-border bank lending to EMEs slowed sharply. Its growth rate dropped to 2.5% in the second and third quarters of 2013 from around 10% over the previous two quarters. Interestingly, the intensity of this deceleration varied considerably across lender and borrower. This raises important questions for policymakers: what drove this variation? And were the factors that drove it mainly on the borrower's or on the lender's side?

We attempt to answer these questions by exploring newly available bank lending data in a regression framework. The new data contain three dimensions that are crucial to this analysis – the nationality of the lending bank, the location of the borrower and the currency composition of the claims. These three dimensions allow

[1] The authors thank Claudio Borio, Dietrich Domanski, Patrick McGuire, Hyun Song Shin, Christian Upper and Philip Wooldridge for useful comments and discussions. Bilyana Bogdanova and Emese Kuruc provided excellent research assistance. The views expressed are those of the authors and do not necessarily reflect those of the BIS.

us to link the evolution of bilateral exchange rate-adjusted flows to drivers connected with both the lender banking systems and the borrower EMEs.

We find that EME-specific factors explain most of the slowdown in cross-border bank lending during the taper tantrum. While factors connected with both the lender banking system and the borrower EMEs are statistically significant, the latter group is responsible for roughly 70% of the explained variation. In particular, we identify the current account balance and the share of cross-border bank lending denominated in US dollars as significant drivers. One lender banking system variable, the change in the average bank credit default swap (CDS) spread during the taper tantrum, accounts for the remaining 30% of explained variation.

The rest of the feature is organised as follows. The first section introduces the data used for our work, in particular the new cross-border bank lending data. The second analyses these data in a regression framework, and the final section concludes with a brief discussion of the main results.

Data

In this section, we first go over the three dimensions of the newly available cross-border bank lending data needed for our empirical analysis. Second, we describe how the growth rate of cross-border bank lending changed across the pairs of lender banking systems and borrower EMEs. Finally, we discuss possible drivers of the variation in cross-border bank lending flows.

The new cross-border bank lending data

In this study, we utilise the recently implemented Stage 1 Enhancements to the BIS international banking statistics (IBS).[2] Given that this is the first time the new data have been used in analytical work, we briefly describe the most relevant features and make a comparison with the previously available BIS IBS data sets (see CGFS (2012) for details).

Any attempt to address our question (ie linking fluctuations in cross-border bank flows both to lender banks and to borrower economy factors) requires three dimensions of cross-border bank lending data:

A. the nationality of the lending bank;

B. the residence of the borrower; and

C. the currency composition of cross-border claims.

We need the first two dimensions (A and B) to identify factors specific to the lender banking system and borrower EMEs, respectively. The nationality of the bank (A) identifies the lender banking system, ie the home of the highest-level banking entity in the corporate chain – which, in turn, is used as a proxy for the decision-making unit for cross-border bank lending.[3] We need the third dimension (C) to

[2] Access to these data is currently limited to central banks and other reporting authorities. Enhanced data will be made available more widely when their availability and completeness improve.

[3] Strictly speaking, the nationality of the lending bank identifies the country of ownership, and not necessarily that of the decision-making unit. In general, the nationality of ownership and decision-

Data availability in the BIS International Banking Statistics

By data dimension Table 1

	Nationality of lending bank (A)	Residence of borrower (B)	Currency composition[3] (C)
Consolidated data[1]	Yes	Yes	No
Locational data[2]			
by residence	No	Yes	Yes
by nationality	Yes	No	Yes
Stage 1 data	Yes	Yes	Yes

[1] The BIS consolidated banking statistics group claims according to the nationality of banks (ie according to the location of banks' headquarters), netting out inter-office positions. [2] The BIS locational banking statistics define creditors and debtors according to their residence, consistently with national accounts and balance of payments principles. [3] In addition to exchange rate fluctuations, the quarterly flows in the locational datasets are corrected for breaks in the reporting population.

control for the impact of currency fluctuations on changes in the outstanding stocks of cross-border bank claims. For instance, a move in the euro/dollar exchange rate mechanically leads to changes in the US dollar value of euro-denominated claims. Thus, the changes in BIS IBS claims, which are expressed in US dollars, also reflect currency movements. The adjustment for currency movements is particularly relevant, because contractions in cross-border lending tend to coincide with large exchange rate movements.[4]

The Stage 1 enhanced data are the first consistent data set to provide all three dimensions at the same time (Table 1). Previously, the BIS IBS data provided information on only two of the above three dimensions. The consolidated data set identified the nationality of the lending banks (dimension A) and the residence of the borrower (dimension B), but did not provide a currency breakdown (dimension C). By contrast, the locational data by residence did reveal the currency composition of banks' cross-border claims (dimension C) as well as the residence of the borrower (dimension B), but they did not identify the nationality of the lending bank (dimension A). Finally, the locational data by nationality contained dimensions A and C, but not dimension B.

The unavailability of all three data dimensions constrained previous studies on the determinants of foreign bank lending to EMEs. For instance, McGuire and Tarashev (2008) used the consolidated data to construct the dependent variable in their model (ie the growth rate of the stock of international claims). As a consequence, they were able to study how the health of individual national banking systems affected foreign lending to EMEs, but only at the cost of working with data that had not been adjusted for exchange rate fluctuations. By contrast, Takáts (2010) used the locational data set in order to construct his dependent

making are more likely to coincide in banking systems that are more centralised (eg in the case of German and French banks) – and, by the same token, they are less likely to do so in more decentralised banking systems (eg with Spanish banks). However, in the case of cross-border bank lending, the overlap between the countries of ownership and decision-making is likely to be stronger than in the case of local lending – which makes nationality a reasonable, though imperfect, proxy for decision-making in this instance. See CGFS (2010) for further discussion of models for international banking.

[4] For instance, when we repeat the full analysis with currency-unadjusted consolidated data, the results of our benchmark estimation change drastically. For details, see the section on sensitivity analysis below.

variable (ie the growth rate of the stock of currency-adjusted cross-border claims). As a result, he was able to work with exchange rate-adjusted cross-border lending flows, but information on the nationality of the lending banks was lacking, which prevented a decomposition of the estimated global home country factor into banking system-specific factors. Avdjiev et al (2012) came closest to using all three required dimensions by combining the locational data by residence with the consolidated data. However, this approximation could not have the detail and precision available in the Stage 1 Enhancements.

Finally, although the new Stage 1 data are not yet complete, they are nevertheless representative. On aggregate, information on the nationality of lending banks is available for about two thirds of the total cross-border claims on EMEs. This ratio varies considerably and tends to be higher for the larger EMEs.

Cross-border bank lending during the taper tantrum

In selecting the sample for our analysis, we aim to include all internationally significant lender banking systems and borrower EMEs.

In particular, we include all 21 lender national banking systems which had more than $10 billion of cross-border claims on EMEs in the new Stage 1 data at end-2013.[5] We also include all 35 EME recipients of cross-border bank lending whose cross-border borrowing exceeded $10 billion at end-2013: Angola, Argentina, Bulgaria, Brazil, Chile, China, Chinese Taipei, Colombia, Croatia, the Czech Republic, Egypt, Hungary, India, Indonesia, Israel, Korea, Kuwait, Lithuania, Malaysia, Mexico, Morocco, Nigeria, Peru, the Philippines, Poland, Romania, Russia, Saudi Arabia, South Africa, Thailand, Turkey, Ukraine, the United Arab Emirates, Venezuela and Vietnam (Graph 1, rows).[6]

Across our sample, the new Stage 1 data reveal a substantial degree of variation during the episode. In particular, we examine the change in the growth rate of cross-border bank lending to EMEs between the taper tantrum quarters (Q2 and Q3 2013) and the two quarters preceding this episode (Q4 2012 and Q1 2013). Among the largest individual lender national banking systems, this change ranged from –13% to +10%. Among the largest borrower EMEs, the change was between –12% and +7%. Smaller lenders and borrowers saw even bigger changes.

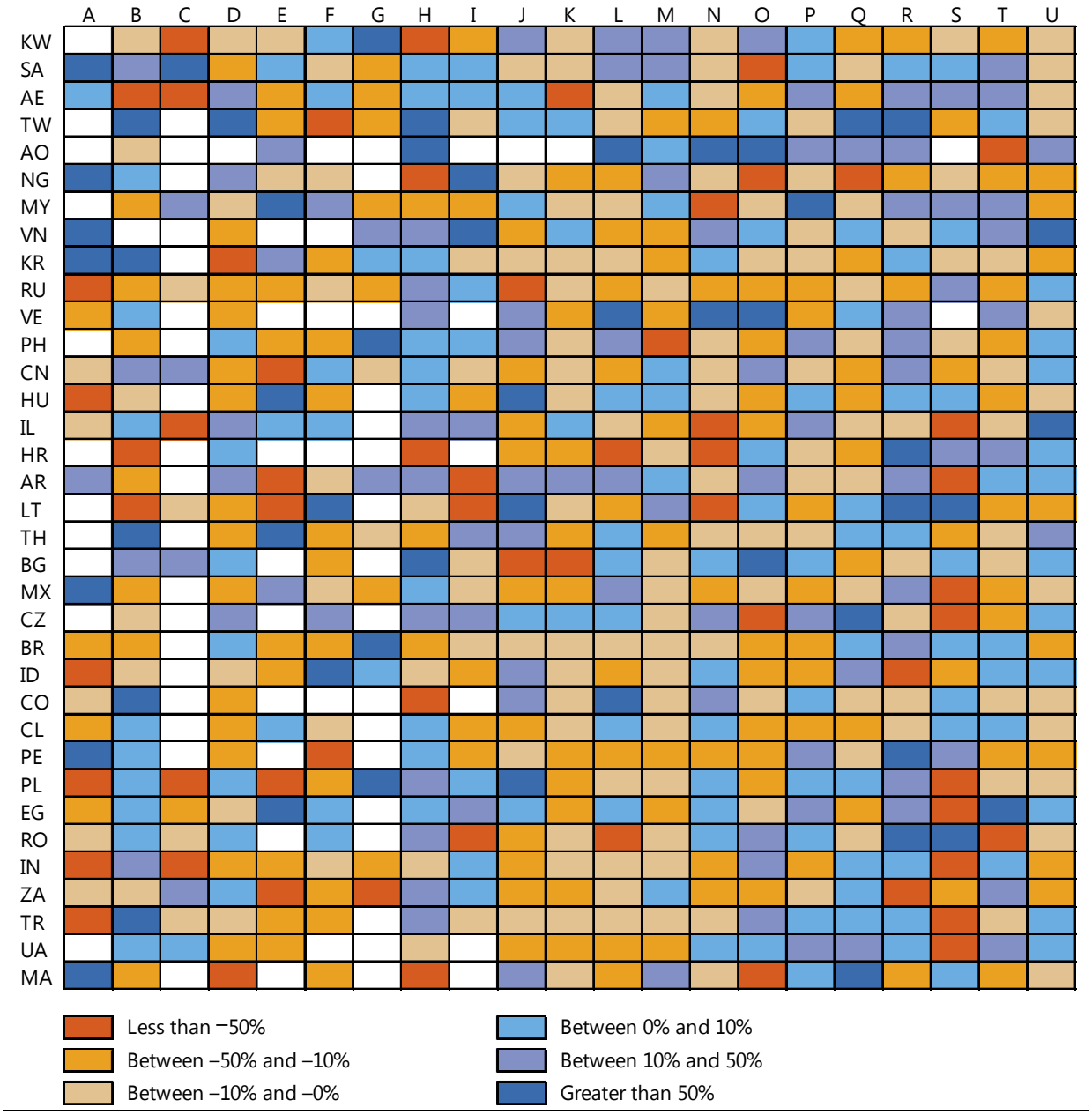
The new Stage 1 data also show that the variation is even greater at the level of bilateral cross-border bank lending flows (ie flows from individual lender banking systems to individual borrower EMEs). Graph 1 displays changes in the bilateral growth rates during the taper tantrum between lender banking systems (columns) and borrower EMEs (rows). For confidentiality reasons, the nationalities of the lender banking systems are not revealed, and colour-coded interval categories are shown instead of exact values.

[5] In order to ensure that our sample is representative, we exclude lender national banking systems whose home country had not started providing complete breakdowns for the Stage 1 data as of Q3 2012 and whose cross-border claims on EMEs are primarily booked in the home country. For confidentiality reasons, we do not list the lender national banking systems included in our sample.

[6] The sample selection for EMEs is based on the locational data by residence. These values may exceed those obtained from the new Stage 1 data because some BIS reporting countries do not yet report Stage 1 data. We exclude offshore financial centres from the sample.

Changes in growth rate of cross-border bank lending during the taper tantrum[1]

By nationality of lending bank (columns)[2] and residence of borrower (rows)[3] Graph 1



AE = United Arab Emirates; AO = Angola; AR = Argentina; BG = Bulgaria; BR = Brazil; CL = Chile; CN = China; CO = Colombia; CZ = Czech Republic; EG = Egypt; HR = Croatia; HU = Hungary; ID = Indonesia; IL = Israel; IN = India; KR = Korea; KW = Kuwait; LT = Lithuania; MA = Morocco; MX = Mexico; MY = Malaysia; NG = Nigeria; PE = Peru; PH = Philippines; PL = Poland; RO = Romania; RU = Russia; SA = Saudi Arabia; TH = Thailand; TR = Turkey; TW = Chinese Taipei; UA = Ukraine; VE = Venezuela; VN = Vietnam; ZA = South Africa.

[1] Change in the average growth rate of cross-border bank lending to EMEs between the taper tantrum episode (Q2 and Q3 2013) and the two quarters immediately preceding it (Q4 2012 and Q1 2013). [2] Lender banking systems, coded in letters, are ordered by the change in the average bank CDS spread between Q2–Q3 2013 and Q4 2012–Q1 2013 (from the largest increase to the largest decline). [3] Borrower EMEs are ordered by the current account balance (from most positive to most negative) in 2012 (expressed as a percentage of GDP).

Sources: IMF, *World Economic Outlook*; Markit; BIS locational banking statistics by nationality; BIS calculations.

Finally, we also undertake a straightforward ANOVA decomposition on the change in the growth rate of cross-border bank lending. This reveals that the variation between lender national banking systems (the columns in Graph 1) is of roughly the same size as the variation between borrower EMEs (the rows in

Graph 1). The decomposition suggests that we should examine factors relating to both lender banking systems and borrower EMEs when analysing what drove the change in cross-border bank lending growth during the taper tantrum.

Possible drivers of cross-border bank lending

Economic theory and past studies of cross-border bank lending suggest a number of economic variables as possible drivers of cross-border bank lending. Given that this is the first study to use the new Stage 1 data, we examine a range of these potential explanatory variables. Furthermore, based on our ANOVA decomposition, we give equal consideration, as potential drivers, to lender banking system- and borrower EME-related factors.

We explore five lender banking system variables: the change in the average bank CDS spread and equity price during the taper tantrum, past real credit and real deposit growth in the home market of banks, and the share of cross-border claims denominated in US dollars. A rise in the CDS spread or a decline in the equity price of the lending bank during the taper tantrum could potentially signal increased levels of bank stress, which would in turn reduce banks' ability to lend. From a different perspective, rapid credit or weak deposit growth in the home market could be a precursor of subsequent funding strains. Finally, a high share of cross-border claims denominated in US dollars could be an indicator of greater reliance on US dollar funding and, consequently, of greater funding strains experienced during the taper tantrum.

We also examine five borrowing EME variables: current account balance, external debt, government budget balance, past real credit growth to the private sector, and the share of cross-border bank lending denominated in US dollars. Higher current account and budget deficits and higher levels of external debt all make borrowers more vulnerable, which typically would reduce banks' willingness to lend. Meanwhile, rapid real credit growth stretches the balance sheets of local borrowers and increases their susceptibility to external shocks (BIS (2014b)). This also tends to reduce banks' willingness to supply cross-border credit to these overstretched borrowers. Finally, a large share of cross-border bank lending denominated in US dollars could indicate, as in the case of lender banking system factors, higher sensitivity to the evolution of US monetary policy.[7]

A preliminary examination of the data suggests that these variables, particularly the change in banks' CDS spreads and the current account balance, could have had an impact on cross-border bank lending. In Graph 1, lender banking systems are ranked according to the change in the average CDS spread during the taper tantrum, while borrower EMEs are ranked according to their current account balance. Indeed, moving from left to right, ie from rising to declining bank CDS spreads, one can see fewer instances of a slowdown in cross-border bank lending. Similarly, moving from top to bottom, ie from current account surplus to deficit, one can see more instances of deceleration. Of course, these broad trends are punctuated with many exceptions – and should be seen only as an inducement to undertake a more rigorous regression analysis.

[7] The exact definitions of all potential explanatory variables are available upon request.

Analysis

We undertake the analysis in three steps. First, we present our benchmark regression, ie the regression specification that best fits the cross-border bank lending data. Second, we discuss the economic implications of the model by decomposing the slowdown in cross-border bank lending into the contributions of its main drivers. Finally, we examine the robustness of the benchmark specification.

Benchmark regression

The data structure and the timing of the taper tantrum guide our basic regression setup. As the BIS bank lending data are reported at a quarterly frequency and the taper tantrum lasted from May to September 2013, we compare the growth rates in cross-border bank lending in Q2 and Q3 2013 with their counterparts in the preceding two quarters (Q4 2012 and Q1 2013).

Furthermore, we weigh each observation by the size of the respective bilateral stock of outstanding cross-border claims at the end of Q3 2012. More specifically, the weight that we assign to each observation is equal to the ratio of the respective bilateral stock to the sum of all bilateral stocks in our sample. Our examination of the data suggests that smaller volumes tend to be highly volatile and probably reflect more bank-specific, or even project-specific, factors. As a consequence, the evolution of larger bilateral cross-border bank lending claims is likely to reflect changes in the economic environment more accurately. In order to control for extreme outliers, we also exclude observations for which the value of the dependent variables is more than 10 standard deviations away from the sample mean.

We select our benchmark explanatory variables through an elimination process. We start by running a panel regression that includes all 10 candidate explanatory variables discussed in the previous section. Then we exclude the variable with the lowest *t*-statistic. Next, we rerun the regression with the remaining variables. We continue this iteration until all remaining explanatory variables are statistically significant at the 5% level.

Our benchmark regression, obtained through the above elimination process, explains the variation of bilateral cross-border bank lending flows with the degree of stress experienced by the lender banking system (as proxied by the change in the average CDS spread) and with the characteristics of the borrower EME (as proxied by the current account balance and the share of cross-border bank lending denominated in US dollars). Formally, we estimate the following equation:

$$\Delta XBC_{b,l} = c + \alpha \Delta CDS_{l} + \beta CAB_{b} + \gamma USDS_{b} + \varepsilon_{b,l}$$

Our dependent variable $\Delta XBC_{b,l}$ represents the change in the average growth rate of the lender banking system *l*'s cross-border claims on borrower EME *b* between the taper tantrum (Q2 and Q3 2013) and the two quarters preceding it (Q4 2012 and Q1 2013). Formally:

$$\Delta XBC_{b,l} = \frac{1}{2}\left(\frac{flow2Q13_{b,l}}{stock1Q13_{b,l}} + \frac{flow3Q13_{b,l}}{stock2Q13_{b,l}}\right) - \frac{1}{2}\left(\frac{flow4Q12_{b,l}}{stock3Q12_{b,l}} + \frac{flow1Q13_{b,l}}{stock4Q12_{b,l}}\right)$$

Our independent variables are defined as follows: *c* is a constant; ΔCDS_l is the change in the average CDS spread of the lender banking system *l* between the taper

Regression results

Table 2

Variables	Coefficient[1]	*t*-statistic	Probability
Lending bank CDS spread change ($\alpha\Delta$CDS)	–1.36	–4.19	0.0000
EME current account balance (βCAB)	2.73	2.83	0.0048
EME USD share of lending (γUSDS)	–134.44	–4.20	0.0000
R-squared (in per cent)	11.72		
Number of observations	658		

[1] All coefficient estimates are multiplied by 1,000 to ease representation.

Source: Authors' calculations.

tantrum (Q2 and Q3 2013) and the two quarters preceding it (Q4 2012 and Q1 2013); CAB_b is the current account balance (as a percentage of GDP) in borrower EME *b* during 2012; $USDS_b$ is the share of cross-border bank lending to borrower EME *b* denominated in US dollars (as of end-Q3 2012); and $\varepsilon_{b,l}$ is the error term. We weigh each observation *b,l* by the share of cross-border claims that the lender banking system *l* had on borrower EME *b* in total cross-border bank lending (across all borrower-lender pairs) in our sample as of end-September 2012.

The benchmark results show that both lender banking system and borrower EME factors were statistically and economically significant drivers (Table 2). The regression fits the data well: it explains close to one eighth of the total variation of a large and heterogeneous sample. All the coefficient estimates are statistically significant at the 1% level, well above the 5% significance threshold used to narrow down the list of variables.

The sign of the estimated coefficient for the lender banking system variable suggests a straightforward supply effect. The negative sign for the change in the CDS spread (α) implies that the greater the increase in the stress experienced by a national banking system during the taper tantrum, the more that banking system reduced its cross-border bank lending.

The coefficient on the EME current account balance (β) is positive, implying that a stronger current account position (ie a larger surplus or a smaller deficit) was associated with more resilient cross-border bank lending growth. Intuitively, EMEs with larger external financing needs on the eve of the taper tantrum were more vulnerable to a sudden change in financing conditions. This is consistent with public discussions during the taper tantrum, which often focused on current account balances as an important indicator of vulnerability for EMEs.

Finally, a higher share of US dollar-denominated cross-border claims on a given EME was associated with a sharper slowdown in lending to its residents. Thus, it appears that the taper tantrum had a larger impact on economies with greater reliance on cross-border US dollar funding.

Economic significance

We next show that the benchmark regression captures an economically significant part of the slowdown in cross-border bank lending by plotting predicted and actual lending slowdowns by lender banking system and by borrower EME.

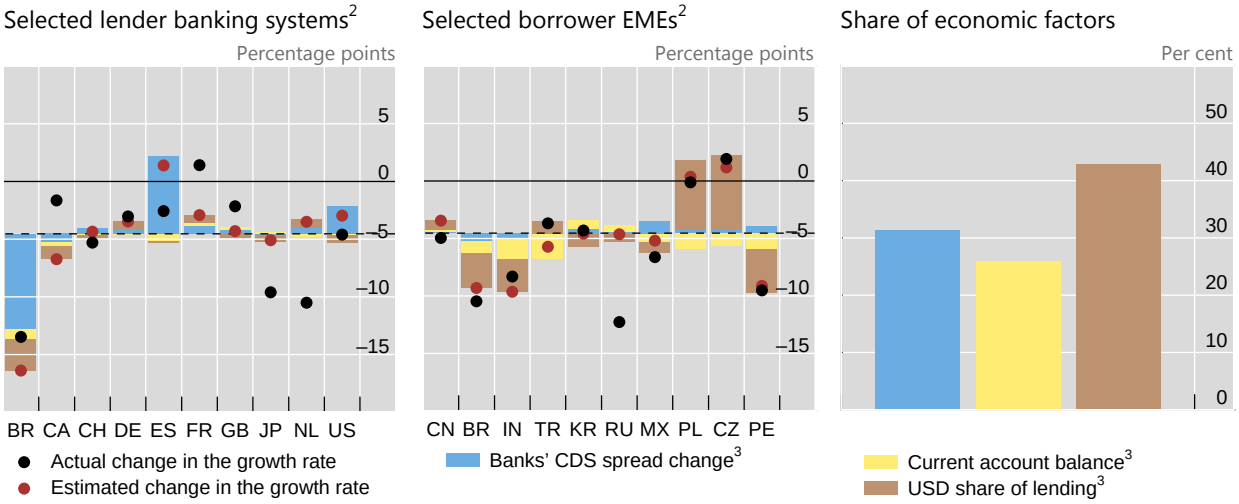
In our decomposition, we focus on deviations from means, as in Avdjiev et al (2012). More specifically, we first create demeaned variables by taking the difference between the regression variables in our benchmark equation and their respective means. We then calculate the contributions by multiplying the demeaned variables by the respective estimated coefficients.

Overall, our benchmark specification explains a large share of the variation in the data. With respect to lender banking systems (Graph 2, left-hand panel), the econometric model accurately captures the slowdowns in cross-border lending to EMEs reported by both advanced economy banks (eg German, Swiss and US banks) and EME banks (eg Brazilian banks): the distance between actual lending (black dots) and estimated lending (red dots) is generally small. However, the fit is not uniformly precise for all banking systems. For example, the model captures neither the surprising acceleration in French banks' lending growth nor the full scale of the slowdowns reported by Japanese and Dutch banks.

In general, the estimates fit better for larger lender banking systems than for smaller ones. Technically, this is due to the volume weighting in the benchmark regression, which puts emphasis on fitting larger bilateral observations. Economically, this also implies that our benchmark regression more closely follows the total volumes of cross-border bank lending but that the price paid for doing so is that it less accurately fits some smaller country-specific growth rates.

The estimates fit even better for borrower EMEs (Graph 2, centre panel). The benchmark specification performs well not only for the largest borrower EMEs (eg China, India, Brazil and Turkey) but also for smaller EMEs (eg the Czech Republic and Peru). This good fit for smaller economies is not necessarily expected, given the

Decomposition of the change in growth rate of cross-border bank lending to EMEs [1] Graph 2



BR = Brazil; CA = Canada; CH = Switzerland; CN = China; CZ = Czech Republic; DE = Germany; ES = Spain; FR = France; GB = United Kingdom; IN = India; JP = Japan; KR = Korea; MX = Mexico; NL = Netherlands; PE = Peru; PL = Poland; RU = Russia; TR = Turkey; US = United States.

[1] Change in the average growth rate of cross-border bank lending to EMEs between Q2–Q3 2013 and Q4 2012–Q1 2013. [2] The reported actual and estimated changes in the growth rates for individual banking systems and EMEs represent weighted averages of the respective bilateral changes, weighted as in the benchmark regression equation (ie by the size of the respective bilateral stock of outstanding cross-border claims at the end of Q3 2012). The individual changes in the growth rates reported in the graph may differ from the respective changes obtained from alternative data sources due to the fact that the new Stage I data set is not yet fully complete (see main text for further details). [3] As defined in the benchmark regression.

Sources: IMF, *World Economic Outlook*; Markit; BIS locational banking statistics by nationality; BIS calculations.

weighting we used in the regression analysis. The most notable exception is Russia, where our model does not predict the full extent of the slowdown.

Our estimates imply that factors associated with borrower EMEs accounted for the bulk of the explained variation in cross-border lending (Graph 2, right-hand panel). All in all, EME factors account for around 70% of the explained variation. Among them, the US dollar share of cross-border lending accounted for around 45% and the current account balance for around 25%. Meanwhile, the factor related to lender banking systems, the change in banks' CDS spreads, accounted for around 30% of the explained variation.

The strong explanatory power of EME-related variables in the benchmark specification potentially explains why our estimates tend to fit borrower EMEs even better than they do the lender banking systems. Although variation across lender banking systems and borrower EMEs is roughly similar, the EME-related variables seem to be able to better capture the EME-specific variation.

In sum, our analysis shows that, even though the initial taper tantrum shock originated from the advanced economies, it was mostly EME-specific vulnerabilities that determined how the slowdown in cross-border bank lending would be distributed across EMEs.

Sensitivity analysis

We examine the robustness of our benchmark results to alternative specifications by conducting a sensitivity analysis. While for the sake of brevity we do not list the detailed regression results, they are available on request.

Our benchmark specification is robust to dropping one variable at a time. In each of the resulting specifications, all estimated coefficients retain their statistical significance, their respective signs and even their magnitudes.

The benchmark results are also robust to the inclusion of additional explanatory variables. In particular, we include three additional borrowing EME-linked variables that might signal vulnerabilities as discussed in BIS (2014a): credit-to-GDP gaps, inflation and government debt levels, but none of these turns out to be significant at the 5% level. Similarly, the other potential explanatory variables that were excluded in the elimination process also remain insignificant when added to the benchmark regression.

Furthermore, the benchmark results remain robust to the exclusion of individual borrower EMEs from the sample. The signs of the coefficients remain unchanged in all cases. In addition, the statistical significance also remains robust in almost all cases: the three explanatory variables from the benchmark regression remain significant at the 1% level in 101 out of 105 possible cases. The robustness of the results is particularly reassuring in the case of China, because it reveals that the benchmark results are not dominated through the regression weighting by the large and relatively stable cross-border bank lending flows to China.

The benchmark results also remain robust to the exclusion of individual lender banking systems from the sample. The sign, size and statistical significance of the coefficient estimates remain robust in almost all cases. The lender bank CDS spread, the current account balance and the US dollar share of cross-border bank lending remain significant at the 5% level in all but one of 63 possible cases.

Finally, we demonstrate that using the new Stage 1 data is critical for our analysis. In particular, when we run the benchmark regression with the consolidated data (Table 1, top row) as the dependent variable instead of the new Stage 1 data, the results become much weaker. The regression loses around half of its explanatory power. Furthermore, the change in the bank CDS spread loses its statistical significance and even reverses its sign.

In sum, the sensitivity analysis delivers two key takeaways. First, the benchmark regression and its coefficient estimates are very robust. Second, it is essential to use the exchange rate-adjusted bilateral flows from the new Stage 1 data.

Conclusion

Our analysis shows that both lender banking system and borrower EME factors explain statistically and economically significantly the cross-sectional variation in cross-border bank lending during the taper tantrum. However, it is the EME-specific factors that are more relevant from an economic perspective: the US dollar share of cross-border bank lending and the current account deficit are jointly responsible for around 70% of the explained cross-sectional variation. The rest is accounted for by the change in the average bank CDS spread during the taper tantrum.

Given that this is the first analysis of the new Stage 1 data, its findings should be interpreted with caution. For instance, the result that borrower EME factors explain more of the cross-sectional variation might partly reflect better data quality along that dimension. Borrower EMEs are natural objects for national statistical data collection efforts, whereas data on lender banking systems come from several sources that may not necessarily be fully harmonised. Future research might shed further light on such issues.

Finally, any interpretation of these results should take into account that cross-border bank flows represent only a part, albeit a considerable one, of international financial flows. Total cross-border bank claims on EMEs are of roughly the same magnitude as portfolio investments in EMEs. While cross-border bank lending is important, non-bank cross-border financing has increased even more rapidly over the past few years, as documented in BIS (2014b) and Chui at al (2014). That said, cross-border bank lending remains a major source of foreign financing in most EMEs. As a result, a better understanding of its drivers would help policymakers.

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Residential property price statistics across the globe[1]

Despite their importance in macroeconomic and financial stability analysis, residential property data are not easily available on a comparable basis. The BIS currently publishes more than 300 price series for 55 countries, among which it has selected one representative series for each country. For 18 countries, it also publishes series that span the period back to the early 1970s. House prices can serve as key indicators of financial stability risks, as property booms are often the source of vulnerabilities that lead to systemic crises.

JEL classification: R30, R31.

Since June 2014, the BIS has published three data sets of residential property prices that currently cover 55 countries. The unique feature of the first data set, besides its wide coverage, is that it contains several series per country, focusing on different segments of the national market. The other two data sets contain one representative series per country, selected by BIS statisticians to enhance cross-country comparability. The second set focuses on broad coverage of the selected series, while the unique feature of the third data set is that it creates long time series for a subset of countries. In this article, we present these data and highlight their usefulness.

Households, analysts and policymakers share a keen interest in property price developments. Buying a house is often the largest single transaction for a household, and the property its largest asset. It is no surprise that house prices are a frequent topic in dinner party conversations. Fluctuations in house prices have a large impact on households' net wealth, and their propensity to spend. In addition, residential property values underpin much of the USD 24 trillion mortgage market in advanced economies.[2] This makes house markets a central element in the analysis of trends in aggregate expenditure, the strength of bank balance sheets and the interactions of macroeconomic and financial stability. Moreover, house prices are relevant to statisticians who compile macroeconomic series on households' wealth, or consumer price indices.

[1] The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS. We wish to thank Claudio Borio, Dietrich Domanski, Hyun Song Shin and Christian Upper for constructive comments on earlier drafts.

[2] Estimated as the sum of outstanding mortgages in Australia, Canada, the euro area, Japan, the United Kingdom and the United States in the first quarter of 2014.

Despite their importance, comparable cross-country data on residential property prices are hard to obtain. The combination of the disaggregated nature of property transactions and the pronounced diversity of the properties themselves complicates the compilation of price indices. Moreover, comparability suffers because of a lack of standardisation and the short time span of many series, a significant shortcoming in view of the length of property price cycles. The data sets published by the BIS are aimed at narrowing these gaps. Their unique features in terms of coverage and comparability should be of use to economists and policymakers alike.

The article is organised in three sections. The first section discusses various statistical aspects related to the construction of price indices. The second section provides an overview of the data published by the BIS. The final section uses the three data sets to illustrate the use of their unique features. It presents a quick overview of international market developments, provides cross-country comparisons of current valuations and highlights the international co-movement of prices. Finally, it also documents the early warning properties of house price growth for episodes of systemic banking stress.

Diversity in the characteristics of house price statistics

One of the main objectives of the residential price series published by the BIS is to provide analysts and researchers with information about house price growth in various countries. Cross-country analysis places a premium on data comparability, and from that perspective property price indices present a number of statistical challenges. In this section, we outline the main factors that can differentiate one house price index from the other.

Property price indices aim to capture the trend in the average price of dwellings in a given area. However, the nature of the property market complicates standardisation in index construction. For one, housing is not a homogeneous good. Properties vary immensely in several dimensions, some of which are not easy to quantify. While segmentation of the market in terms of location, size or age of the property may be straightforward, controlling for quality of construction, customer appeal or level of comfort is less obvious. In addition, property changes hands through bilateral transactions and not in centralised markets.[3] This requires mechanisms to collect dispersed price information in order to create a representative index, as indices with different characteristics provide different messages even for the same country (see box). These practical difficulties also explain why in many cases statistics have been gathered (at least initially) by private sector firms and associations with specific commercial interest in the housing market while public sector efforts have lagged behind. This pattern is even more pronounced in the case of commercial property, where heterogeneity and dispersion of transactions are even greater and where hardly any official statistics exist.[4]

[3] Central property registries can function as surrogate centralised marketplaces for the purpose of compiling price indices. Unfortunately, these registries are not always organised in a way that makes it easy to extract useful information on price and property characteristics.

[4] BIS researchers have used commercial property price indices, mostly sourced from proprietary commercial compilers, for research and analysis, including for various editions of the BIS Annual Report.

Property price indicators differ in three principal dimensions: their geographical coverage, the source of information on property values, and the approach to controlling for differences in property characteristics.

The old adage "Location, location, location!" points to the key driver of real estate value. Prices of properties in different locations can diverge persistently even within the same region. Demographics, tastes and demand from foreign buyers may be pushing up the price of houses in highly desirable spots at the same time as properties in other areas are languishing due to lack of demand or a decline in local economic activity. During the 2007–09 crisis, properties in Manhattan and central London maintained their value while in the rest of the United States and the United Kingdom average home values were plummeting. Aggregate price indices that are skewed towards one or the other segment may convey a distorted picture of average developments. That said, for some purposes it is useful to focus on market segments. For instance, given the wider economic disruptions created when a large stock of outstanding debt defaults, the assessment of the macro-financial risks of rapid growth in mortgage credit would naturally focus on the booming segment of the housing market. This is particularly true for very diverse countries such as the United States, and often coincides with properties in major cities. In practice, the majority of the published series refer to country-wide averages, but for about 13 countries the data cover only prices in major cities or the capital alone (Table 1, left-hand set of columns).

Indices differ also in terms of the primary source of price information (Table 1, middle set of columns). The ideal source would be actual transaction prices for a representative set of properties. Comprehensive sets of transaction prices can be collected from land registries, where these exist. However, widespread tax avoidance in some countries can introduce bias in recorded transaction prices compared with real market property values. Moreover, depending on the available resources, registries may keep only incomplete records of the characteristics of dwellings, hence complicating the quality adjustment of price indicators. Similar factors explain the time lag between the publication of official indicators and less comprehensive indicators compiled from private sources.[5]

Tools that facilitate the workings of the real estate and mortgage markets may also be a source of house price information, as are advertised prices, collected from the internet, newspapers or the databases of real estate agents. Advertised prices may capture trend shifts even before transactions take place. However, their usability is limited by systematic differences vis-à-vis actual transaction prices (for example, owners listing a high asking price or failing to sell the property), which may also be time-varying (for instance, close to turning points in demand or supply cycles). Alternatively, in countries with developed mortgage markets, yet another source of information is appraisals made as part of the loan approval process. Experts' valuations are likely to be closer to final transaction prices than advertised prices but may also be subject to biases if they are primarily driven by lenders' desire to ensure adequate cover for their exposure.

The data source or the purpose of the indicator also influences its coverage. For example, appraisal-based indicators usually do not incorporate price data from cash purchases; and owner-occupied property price indices measure only developments in the prices of dwellings owned by the households that live in them. They exclude

[5] For more details, see Eurostat (2013), Chapter 9.

Characteristics of series included in the three data sets

Summary of attributes for all series available for each country — Table 1

Country	Number of series	Geographical coverage			Source of price information			Quality adjustment			Series starting year	
		All	Cities	Other	Trans-actions	Appraisal	Adver-tised	None	Size only	Sophis-ticated[1]	Selected	Long
Australia	6		✓		✓					✓	2003	1970
Austria	16	✓	✓	✓	✓		✓		✓	✓	2000	
Belgium	9	✓	✓	✓	✓			✓	✓	✓	2005	1970
Brazil	1		✓			✓		✓			2001	
Bulgaria	1		✓		✓		✓		✓		1993	
Canada	3	✓			✓	✓				✓	1970	1970
China	3		✓		✓				✓		2011	
Croatia	3	✓	✓	✓	✓					✓	1997	
Cyprus	3	✓				✓				✓	2002	
Czech Republic	7	✓			✓	✓			✓	✓	2008	
Denmark	7	✓			✓					✓	1971	1970
Estonia	7	✓	✓		✓				✓		2005	
Euro area	1	✓									1980	
Finland	17	✓	✓	✓	✓					✓	2005	1970
France	10	✓	✓		✓					✓	1996	1970
Germany	48	✓	✓	✓	✓	✓		✓	✓	✓	2003	1970
Greece	18	✓	✓	✓	✓	✓	✓		✓	✓	2006	
Hong Kong SAR	3	✓			✓				✓		1993	
Hungary	5	✓	✓		✓				✓	✓	2007	
Iceland	1		✓		✓				✓		2000	
India	1		✓		✓					✓	2009	
Indonesia	5		✓		✓	✓	✓	✓			2002	
Ireland	8	✓	✓	✓	✓					✓	2005	1970
Israel	1	✓			✓					✓	2001	
Italy	1	✓			✓					✓	1990	1971
Japan	12	✓	✓		✓	✓	✓		✓	✓	1955	1970
Korea	1	✓			✓					✓	1986	
Latvia	3	✓			✓					✓	2006	
Lithuania	1	✓			✓				✓		1998	
Luxembourg	5	✓			✓					✓	2007	
Macedonia	1		✓				✓			✓	2005	
Malaysia	4	✓	✓		✓			✓		✓	1999	
Malta	1	✓					✓	✓			2000	
Mexico	1	✓				✓				✓	2005	

[1] Includes all other types of quality adjustment methods (hedonic regression, repeat sales, stratification, etc).

Source: BIS.

- Continued -

Table 1

Country	Number of series	Geographical coverage			Source of price information			Quality adjustment			Series starting year	
		All	Cities	Other	Trans-actions	Appraisal	Adver-tised	None	Size only	Sophis-ticated[1]	Selected	Long
Morocco	5	✓	✓		✓					✓	2006	
Netherlands	6	✓			✓			✓		✓	1995	1970
New Zealand	3	✓	✓			✓				✓	1979	1970
Norway	9	✓	✓		✓				✓	✓	1992	1970
Peru	1		✓						✓		1998	
Philippines	2		✓		✓				✓		2008	
Poland	14	✓	✓	✓	✓		✓		✓	✓	2006	
Portugal	2	✓			✓		✓			✓	1988	
Romania	6	✓	✓	✓	✓					✓	2009	
Russia	2		✓		✓				✓		2001	
Singapore	4	✓							✓		1998	
Slovakia	1	✓					✓		✓		2005	
Slovenia	9	✓	✓	✓	✓					✓	2007	
South Africa	4	✓			✓			✓			1966	
Spain	3	✓				✓			✓		1995	1971
Sweden	2	✓			✓			✓		✓	1986	1970
Switzerland	5	✓					✓	✓			1970	1970
Thailand	4		✓			✓				✓	2008	
Turkey	2	✓				✓				✓	2010	
United Kingdom	5		✓	✓	✓	✓				✓	1968	1970
United States	3		✓		✓					✓	1975	1970

[1] Includes all other types of quality adjustment methods (hedonic regression, repeat sales, stratification, etc).

Source: BIS.

sales of properties purchased with the intention to let or resell, a potentially important share of the market in countries with low home ownership rates (eg Germany) or in periods of intense speculation in residential property.

Finally, a price index must separate price movements from changes in the characteristics of the underlying properties. Index compilers have adopted methods of varying sophistication to perform this quality adjustment (Table 1, right-hand set of columns). The quality adjustment process is more challenging in the case of property price indices than for consumer or producer price indices, and the choice is partly driven by data availability. The most basic approach uses the average house price in a given area. This is the only possibility when the main characteristics of the dwellings are not collected, or cannot be processed by the compiler. It can produce misleading messages if the distribution of characteristics in the cross section of properties surveyed varies over time. Indicators based on price per square metre are calculated when only the size is available. More elaborate quality adjustments take into account other characteristics and follow methods such as hedonic regression,

stratification, and repeated sales or appraisals.[6] Some of these methodologies are better at adjusting for general trends in quality over time (eg hedonic regressions or indices based on repeat sales), while others are more geared towards controlling for cross-sectional differences in quality at a given point in time (eg stratification or the ratio of sales price to appraisal value).

The demand for comparable price statistics led to Eurostat's publication of the Handbook on Residential Property Prices Indices (HRPP) last year. The HRPP gathers recommendations on best practices for the compilation of property price indices in the context of different user needs. The HRPP built on work undertaken by a number of international organisations (including the BIS) to identify the user requirements from the point of view of economic and policy analysis.

The implementation of HRPP recommendations runs into constraints related to the availability of data and resources. Generally, public sector compilers are more likely to follow its recommendations than their private sector counterparts. Residential property price indices based on the recommendations of the handbook have been constructed in many European countries, but progress is slower elsewhere.

The BIS property price statistics

In 2009, the G20 asked the BIS and its member central banks to collect and publish residential property prices. The request was made in the context of the Data Gaps Initiative, which aims to improve the availability and comparability of economic and financial data across countries, and follows long-standing efforts by the BIS to collect and use cross-country data on property prices.

The BIS work on cross-country house price data dates back to the late 1980s (BIS (1989)). An expanding set of price series have been collected from various national sources (both public and private) and cover both residential and commercial properties. The information has been extensively used in analysis and reported in publications, such as several editions of the BIS Annual Report. BIS analysis has focused on the determinants of property prices (Tsatsaronis and Zhu (2004), Égert and Mihaljek (2007), Glindro et al (2010), Takáts (2012)) and the link between property prices and credit (Davis and Zhu (2005)) as well as the information content of real estate prices for financial stability (Borio and Drehmann (2009)). Borio et al (1994) constructed an indicator of aggregate asset prices combining equity and property prices, and explored its link with money, credit, interest rates, output and inflation.

The residential property price series that are published by the BIS are organised in three data sets: the Detailed data set that includes all the original series collected for each country, the Selected series data set that includes one representative price series per country, and the Long series data set that presents a price series with a long time span which also satisfies some minimum comparability criteria across countries. These three data sets are discussed in more detail below. Table 1 provides a succinct overview of the range of series in the three data sets for each country.

[6] See Eurostat (2013), Chapters 4–7.

The Detailed data set: several series per country

The BIS started to publish monthly residential property prices in July 2010. The coverage of these statistics has expanded from an initial set of 37 countries to 55 today, including 18 G20 countries and all 28 EU members. The total number of series published currently exceeds 300, as, for several countries, more than one series is available. Irrespective of the original compiler, all residential property price series are reported to the BIS by central banks, which also monitor their quality.

The series published on the BIS website differ from country to country in terms of type of property, area covered, property age, priced unit, compilation method and seasonal adjustment. For many countries, residential property price indices cover the entire market, encompassing all types of dwelling throughout the country concerned in both new and existing dwelling markets. For other countries, the coverage of the compiled series is more limited, either in terms of types of dwelling, from a geographical perspective, or regarding the market. In general, the BIS has made an effort to collect price indices that have been compiled following the HRPP recommendations, and publishes extensive descriptive information regarding source, coverage and compilation method alongside each series.

The Selected series data set: one series per country

Faced with multiple series for a country, an analyst must often confront the issue of representativeness. The Selected Representative series data set, published by the BIS, provides a possible answer by including only one house price indicator per country.

As far as possible, the selected series cover all types of dwelling (flats and houses, new and existing) throughout the country. Indicators with such a broad coverage help assess aggregate household wealth and are thus useful for the analysis of financial vulnerabilities linked to household indebtedness.[7] In addition, such a broad indicator can be the best to use for international comparisons, and for this reason the selection also took into account the HRPP criteria.[8] The resulting Selected series data set is as homogeneous as feasible without, however, fully eliminating all discrepancies.

To assist analysts who are interested in ready-to-use comparable price series, these selected series are of a quarterly frequency and are updated once in each quarter.[9] They are rebased, deflated by the CPI, and presented as both levels and year-on-year growth rates.[10]

[7] This is, of course, subject to the caveat raised earlier about diverging trends in major segments of the property market.

[8] International comparisons of less aggregated data (for example, based on cities or specific types of dwelling) are complicated because of the diversity in the definition of these segments as well as the unavailability of the relevant series in many countries. Moreover, the importance of each segment varies considerably across countries.

[9] The series in the Detailed data set are presented at the same frequency as originally published by the compiler.

[10] A note on residential property price developments accompanies the quarterly publication, analysing the recent evolutions of these indicators.

Diversity of residential property price statistics: the German case

The Detailed data set (see main text) includes 48 indicators for Germany covering different segments of the market and following different methodologies. The four most representative series are all reported at least quarterly and are quality-adjusted, but differ in many other aspects (Table A). Two indices are compiled by the private sector and the other two by public sector agencies. More importantly, the indicators vary in their regional coverage, refer to different types of property, use different approaches for the quality adjustment and have different starting dates as well as reporting lags.

Characteristics of four residential property price indicators

Table A

Compiling institution	Sector of compiler	Data coverage	Quality adjustment	Starting date	Reporting lag
Statistisches Bundesamt (Federal Statistical Office)	Public	All dwellings (transactions)	Hedonic regression	Q1 2000	9 months
Verband deutscher Pfandbriefbanken (vdp)	Private	Mortgage-financed owner-occupied dwellings (appraisals)	Hedonic regression	Q1 2003	1½ months
Bundesbank (based on bulwiengesa AG)	Public	Flats in the 7 largest cities (transactions and appraisals)	Method of typical cases	Q1 2008	3 weeks
Hypoport (EUROPACE)	Private	Dwellings (based on mortgages on EUROPACE platform for brokerage)	Hedonic regression	Q1 2005	18 days

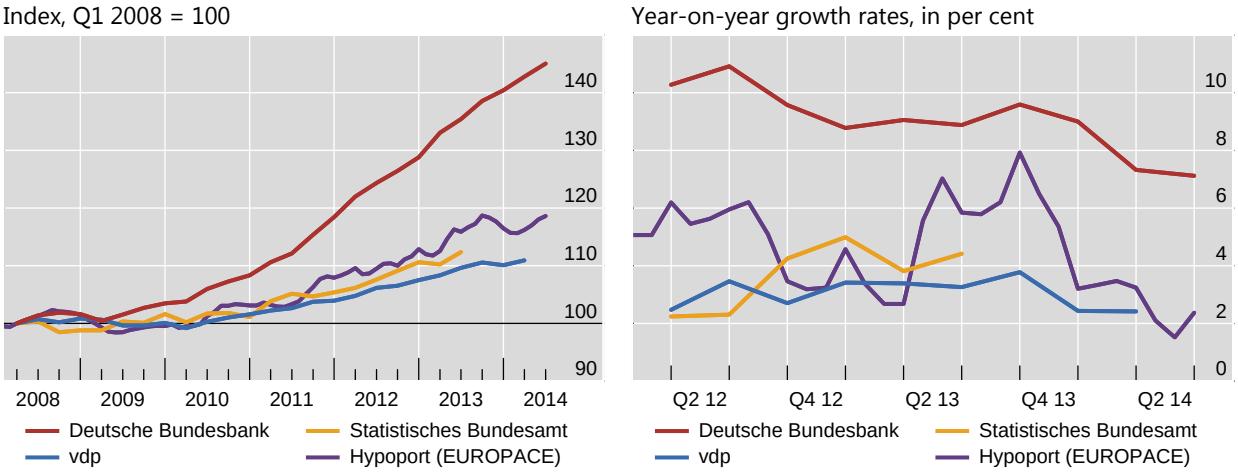
The official indicator compiled by the Federal Statistical Office covers most of the housing market, but it is only available with a long reporting delay. Analysts interested in the most recent developments might prefer the Verband deutscher Pfandbriefbanken (vdp) indicator. The Hypoport (EUROPACE) indicator is even more timely but covers just 15% of overall transactions, and even though it has a monthly frequency, the data represent moving quarterly averages. The Bundesbank indicator, based on data from bulwiengesa AG, is the only one focusing solely on urban properties. The Bundesbank compiles an indicator that covers the entire country (not listed in the table) that is available only at an annual frequency.

The four price indicators convey somewhat different messages both about longer-term trends and about shorter-term developments. Graph A plots the recent history of the four indicators. Looking at longer-term trends (Graph A, left-hand panel), the three country-wide indicators convey a similar picture, placing the cumulative growth rate since the beginning of 2008 in the range of 11% (vdp) to 16% (Hypoport). However, only the Bundesbank indicator shows the pronounced price increase registered for flats in major cities, where prices have climbed by a cumulative 45% since 2008. The picture is even more mixed in quarter-to-quarter movements (Graph A, right-hand panel). House price growth estimates calculated on the basis of the Bundesbank and vdp indices differ substantially, but they are both much less volatile than that based on the Hypoport series, arguably reflecting the shifting sample of the properties listed on the online brokerage that supplies the price information. The graph also illustrates the reporting lag of the Federal Statistical Office indicator.

The BIS has chosen the vdp index for inclusion in the Selected data set (see main text) because of its broad coverage of properties and its short reporting lag.

The Long data set series (see main text) for Germany also uses the vdp index for the period starting in 2003. Prior to that date, the long series is constructed on the basis of price indices referring to properties in western Germany. Going backwards in time, the long series uses the historical time series of the Bundesbank on western German dwelling prices for the period 1975–2002 and sales price data in four cities from a private sector source (Ring Deutscher Makler) for the period 1972–74. For the first two years (1970–71) and in the absence of house price data, the series uses construction cost data as a proxy indicator. For the years where only annual data were available (ie prior to 2003), the quarterly series was constructed using the Chow-Lin (Chow and Lin (1971)) interpolation procedure based on the quarterly pattern of the construction cost index.

Nominal house price indices in Germany — Graph A



Sources: See graph legend and Table A.

Long series data set: stretching the time dimension

Many questions can only be answered by analysing long time series of property prices.[11] The BIS also publishes a Long series data set on residential property prices, which extends the Selected series for 18 advanced economies with historical data that go as far back as 1970 or 1971 on a quarterly basis.

This work has been driven by the BIS in close coordination with national authorities, based on existing data. These data originate from various sources such as central banks, national statistics offices, research institutes, private companies and academic studies. They rely on different methodologies and can cover heterogeneous types of geographical area and types of dwelling. The resulting long series for each country start from the series in the selected data set, extended backwards with information from alternative sources, using standard statistical techniques to fill any gaps.[12]

Ongoing improvements

The three data sets continue to expand in three ways. The first goal is to keep increasing the number of countries included in the data sets, for instance by adding price series for the remaining two G20 countries (Argentina and Saudi Arabia).

[11] See eg Borio et al (1994) and Drehmann et al (2012).

[12] The documentation accompanying the long series data set provides a full explanation of the sources and methodologies used (http://www.bis.org/statistics/pp_long_documentation.pdf). For instance, in order to interpolate annual values and construct quarterly series, the Chow-Lin procedure (Chow and Lin (1971)) was used with construction costs or the housing component of the CPI as reference series (or a combination of the two).

The second goal is to broaden the collection of quality-adjusted price indices that cover the whole residential property market (all types of dwelling and all locations in a given country). For the moment, such series are available for about two thirds of the 55 countries in the data set (Table 1).

The third goal is to enrich the coverage of the long series data set by adding more countries with price series that meet the comparability standards, and by extending the existing series back in time, whenever this is possible.

House prices as input to economic analysis

This section highlights the usefulness of the three BIS residential property price data sets for different types of analysis that relies on comparisons across countries and time. These range from obtaining an overview of recent price developments and trends to the identification of common drivers in price dynamics and stylised facts in their relationship with macroeconomic and financial stability.

House price trends internationally

Lately, house price developments have displayed greater diversity across countries than they did in the immediate aftermath of the crisis. Analysis of the selected price series shows that in some advanced economies, over the past year, real house prices halted their decline and even staged a recovery while in others they continued their downward trend. In contrast, in most emerging market economies outside Europe, house prices generally rose (Graph 1).

Year-on-year residential property prices, deflated by CPI, rose by 9.5% in the United States and 6% in the United Kingdom. Real house prices also grew, by 7% in Canada, 7.7% in Australia and 2.2% in Switzerland, three countries that were less affected by the crisis, as well as in some countries that were severely affected by the crisis, such as Ireland (+7.2%) and Iceland (+6.4%).

Real price growth remained in negative territory in Japan (–2.6%) and was generally weak or negative in continental Europe. Prices rose in Germany (+1.2%) and the Nordic countries (+1.7% in Denmark and +4.8% in Sweden), but continued to fall in the euro area's southern periphery (Italy, –5%; Spain, –3.8%; Portugal, –1.2%; and Greece, –6%).

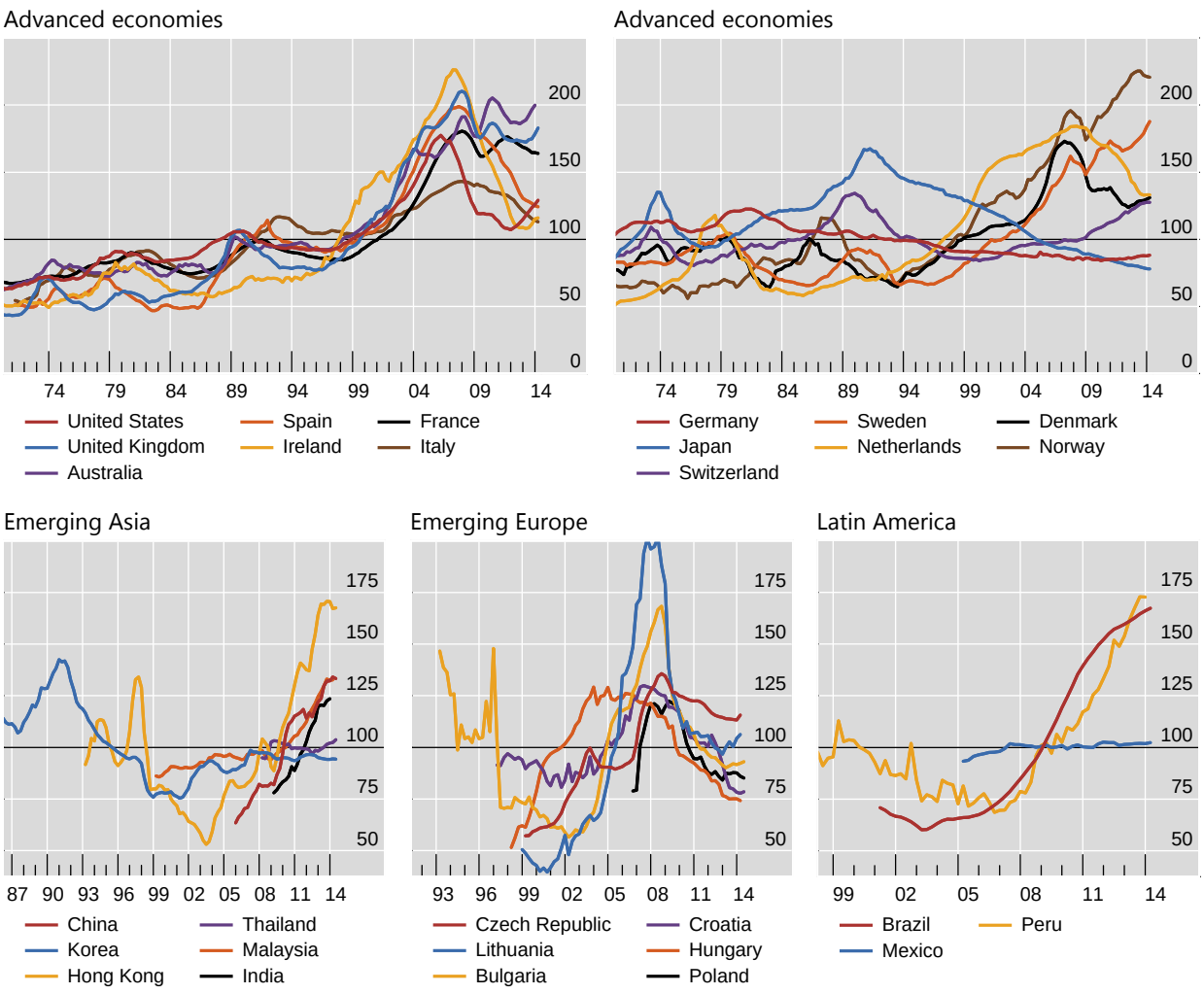
House prices generally grew in emerging regions outside Europe. In Asia, year-on-year growth rates remained high in a number of countries in the first quarter of 2014 – for instance, prices increased in real terms in China (+13%), the Philippines (+13%) and Malaysia (+5%). In Latin American countries, the increase in real residential property prices was more moderate. Prices in Brazil increased by 3.9% in the first quarter of 2014, whereas in Mexico real prices were mostly stable compared with one year ago. Price developments were mostly negative among central and eastern European countries, but prices in the Baltic countries rebounded sharply.

Sustainability of house prices: valuation benchmarks

Are current house prices sustainable? Property valuations are a subject of intense debate given the inherent subjectivity of the assessment and the volatility in the

International house price indices[1]

Full sample = 100 Graph 1



[1] Figures are CPI-deflated and seasonally adjusted.

Sources: National data; BIS long series and selected property price database.

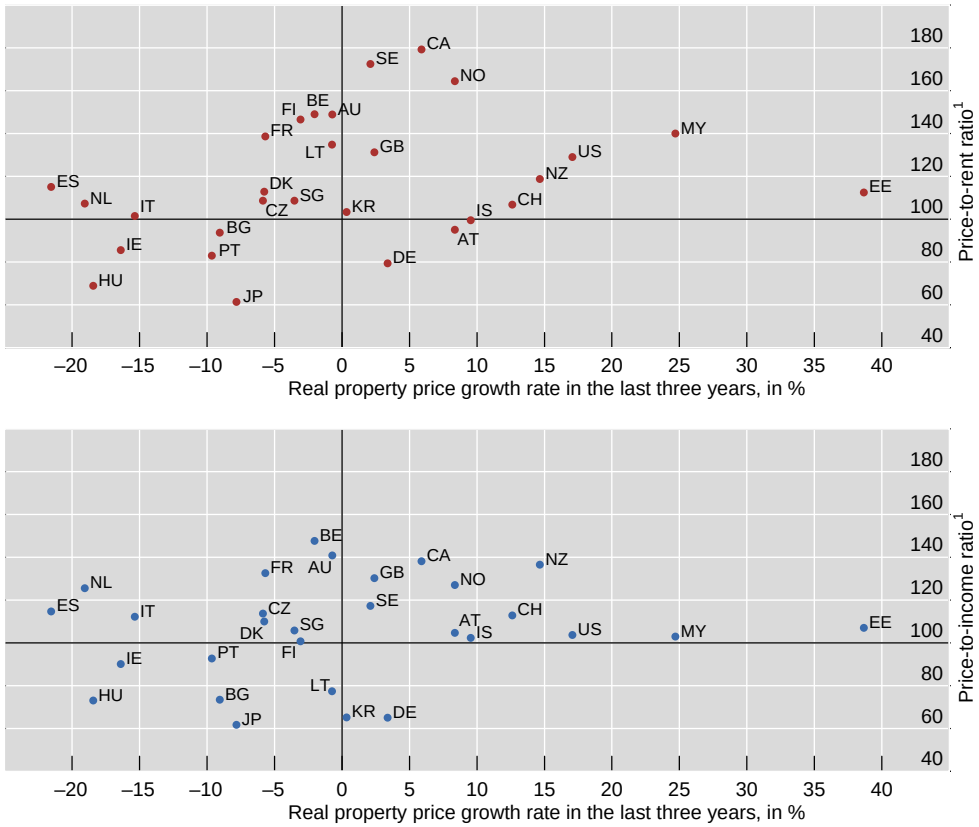
demand trends. Comparisons of recent developments across countries and benchmarking against historical valuation guides can provide additional insights with which to assess the sustainability of recent house valuations. Two such valuation guides widely used among economists and practitioners are the ratio of rental income to the purchase price of the property (the housing asset equivalent to the dividend ratio for stocks) and the ratio of house prices to household income (a metric of affordability).

Graph 2 juxtaposes recent house price growth rates with the deviation of current valuation ratios from their longer-term average values for the countries in the database with sufficiently long series.[13] The horizontal axis in both panels

[13] We require that we have at least 15 years of data for both ratios. The choice is somewhat arbitrary, but consistent with the observation that credit and property cycles are of average duration in excess of 15 years (Drehmann et al (2012)). We use the Selected series for all countries and, where available, the long series to calculate the historical average of the ratio in each panel.

Relative benchmarks for house prices

Graph 2



AU = Australia; AT = Austria; BE = Belgium; BG = Bulgaria; CA = Canada; CH = Switzerland; CZ = Czech Republic; DE = Germany; DK = Denmark; EE = Estonia; ES = Spain; FI = Finland; FR = France; GB = United Kingdom; HU = Hungary; IE = Ireland; IS = Island; IT = Italy; JP = Japan; KR = Korea; LT = Lithuania; MY = Malaysia; NL = Netherlands; NO = Norway; NZ = New Zealand; PT = Portugal; SE = Sweden; SG = Singapore; US = United States.

[1] In Q1 2014; full sample = 100.

Sources: OECD; AMECO; national data; BIS long series and selected property price database; BIS estimates.

measures the three-year growth rate of residential property prices for each country on the basis of the selected price series. The graph clearly shows the very different recent experience across countries, with declines of more than one quarter in some countries and price hikes in excess of one third in others. Are these movements indicative of market corrections or, instead, of shocks that suggest overshooting in one direction or the other?

The vertical axis in the top panel shows the most recent value of the ratio of house prices to rents, rebased using its historical average. A value of 110 indicates that the current ratio is 10% higher than the historical average. Countries are quite dispersed with respect to this benchmark. While for most countries the current ratio implies that price movements are not diverging from rental values in ways that imply unsustainability, for a number of other countries current property prices are much higher than those implied by the historical relationship to rents. A priori, this could be a reason to expect a price correction in the future. Interestingly, some of these countries have experienced only moderate price growth recently (eg Canada, Norway and Sweden), or even price declines (eg Australia, Belgium and France).

The vertical axis in the bottom panel shows the most recent value of the affordability benchmark: the ratio of prices to disposable income per capita, also rebased using its historical average. The graph suggests that for most countries the current ratio is not too far from this benchmark, suggesting that prices have not diverged dramatically from income trends. For a number of countries, however, current property prices are at least one fifth higher than those implied by the historical relationship to incomes, suggesting potential downward pressures on real house prices. This might lead to a reversal or moderation of recent growth (eg in Canada) or a further sliding of prices (eg in Belgium and France). This argument would be more compelling for markets where prices have grown rapidly in the recent past, and where income growth is projected to be rather moderate.

House price cycles and international co-movement

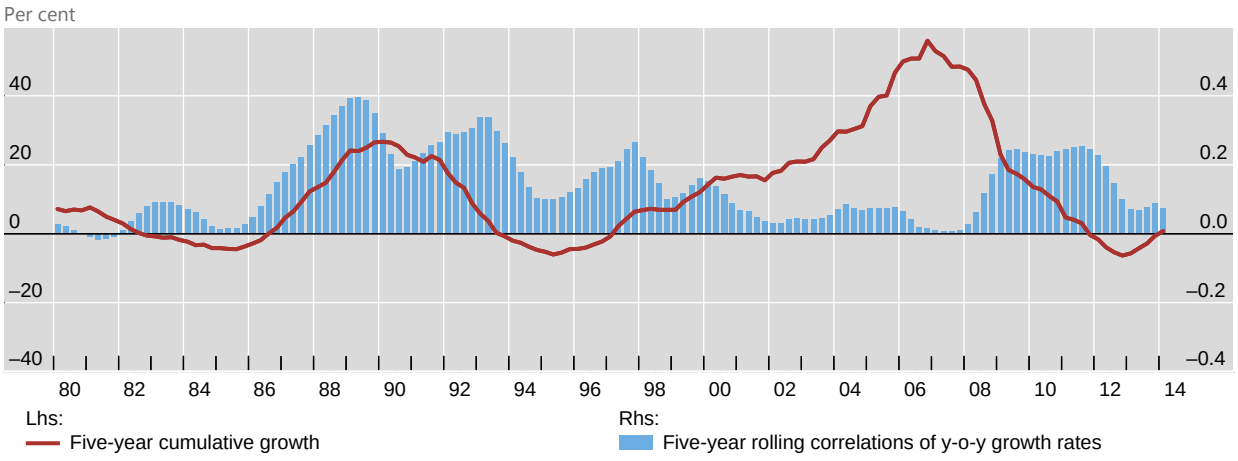
Long time series are also useful for understanding the dynamics of house prices. Research has pointed to long cycles in property prices that are associated with similar cycles in the availability of credit (Drehmann et al (2012)). Graph 3 shows the average growth rate of real house prices across all countries in the Selected and Long series databases over five-year rolling time windows (red line). The series shows the remarkable regularity of a global cycle with length in excess of 10 years and of increasing amplitude over time.

Interestingly, the intensity of house price co-movement varies over time (blue bars). It was generally high for the years between the mid-1980s and late 1990s, whereas it declined markedly during the boom years of the first decade of this century, only to increase again in the aftermath of the global financial crisis. Closer inspection suggests that while most of the time the intensity of co-movement mirrors the direction of average real property prices, there are periods when the two move in opposite directions (1989–93, 1997–99, 2000–08).

House prices as early warning indicators for financial instability

How can property prices contribute to financial stability analysis? Work at the BIS

Asymmetric co-movement of house prices across countries[1] Graph 3



[1] Calculated using CPI-deflated residential property prices across all countries in the database; mean values.

Sources: BIS long series and selected property price database; authors' calculations.

has pointed to the early warning indicator properties of real estate prices. Leverage-fuelled housing booms that turn into busts have so often been at the very heart of episodes of systemic distress. Historical experience has demonstrated that the interactions between rapidly growing house prices and excessive credit expansion are a tell-tale sign of the build-up of vulnerabilities in the household sector and the source of future losses for banks (Borio and Drehmann (2009)).

We follow Drehmann and Juselius (2014) to illustrate the statistical relationship between residential price booms and systemic banking crises in the form of the AUC statistic.[14] In short, the AUC measures the success rate of a particular indicator in correctly predicting future occurrences (in this case, a systemic crisis) while at the same time minimising false positive signals (ie flagging a potential crisis without one occurring). The closer to unity the value of the AUC for a given indicator at a specific horizon, the more informative the indicator.

The left-hand panel of Graph 4 shows the AUC metric for real property price growth over forecast horizons that range from 20 quarters to one quarter prior to a banking crisis.[15] The AUC for the house price indicator is clearly above 0.5, the threshold for being informative (see footnote 14), for several years prior to the crisis. However, the quality of its signal drops significantly in the five quarters prior to the crisis date. This is because property price declines are in many instances a hallmark of the early stages of a financial bust. However, up to that point the signal they emit is quite stable.

Property prices, credit booms and systemic crises

AUCs for different forecast horizons — Graph 4

The horizontal axis denotes the forecast horizons in quarters before crises (the timing of which is denoted by the zero point). The vertical axis denotes the AUC. The horizontal line at 0.5 corresponds to the AUC value of a completely uninformative indicator. The blue line shows the AUC of the indicator for the given horizon.

Source: Drehmann and Juselius (2014).

[14] The area under the curve (AUC) captures the trade-off between true positives and false positives for the full range of policymaker preferences (see Box A in Drehmann and Tsatsaronis (2014) for a description). A completely uninformative indicator has an AUC of 0.5: it is no better than tossing a coin. The greater the difference of the AUC from 0.5, the better the indicator balances the trade-off between missed crises and false positives. The perfect indicator has an AUC of 1 or zero, depending when higher or lower values of the indicator predict crises.

[15] The analysis is based on approximately 50 crisis episodes (see Drehmann and Juselius (2014) for details).

The performance of property prices dramatically improves when their signals are combined with those of other early warning indicators, and in particular indicators more directly linked to the behaviour of credit. The right-hand panel of Graph 4 shows the AUC of a signal combining real property growth and the credit-to-GDP gap, defined as the difference of the credit-to-GDP ratio from its historical trend.[16] The AUC of the combined indicator is much higher than that of real property price growth, and most importantly it stays high throughout the forecast horizon up to the crisis date.

Conclusions

House prices are important inputs to conjunctural analysis of macroeconomic and financial stability risks as well as to research into the interactions of the real and financial sectors. The three sets of residential price data published by the BIS should provide analysts of international housing markets with a wealth of easily accessible and comparable data on price developments. This should stimulate further analysis, including in the form of cross-country benchmarking of valuations and the commonalities in house price dynamics. In addition, the availability of price series with long time spans should stimulate research on property price cycles and interactions with other macroeconomic and financial variables.

The BIS residential price series could potentially also act as a catalyst in improving the availability of property price statistics. For one, it may stimulate efforts towards greater standardisation of the statistical processes underpinning the national compilation of these data. Importantly, this could possibly extend to the compilation of comparable price indices for commercial property prices. Recalling that exposure to frothy commercial real estate markets was at the root of many an episode of banking system stress, this would greatly enhance our analytical tools. Data on commercial property markets are very patchy and hard to come by, at the national level and especially across countries.

[16] The indicators are combined by considering that a signal has been emitted if either of the two is signalling (Drehmann and Juselius (2014)).

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